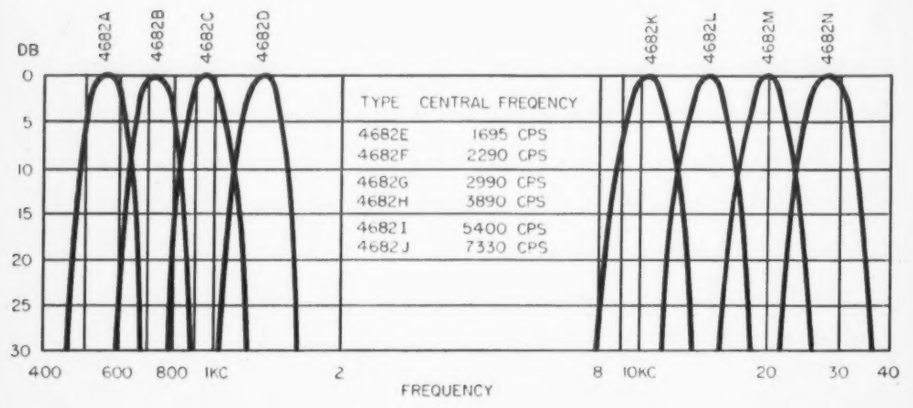
May 1958

SIGNAL

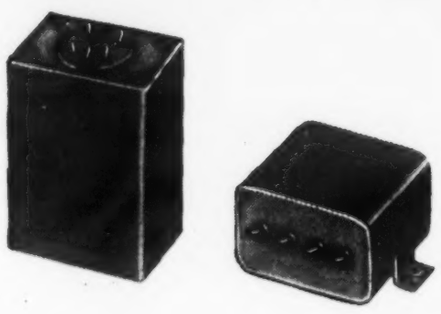
AFCEA Salutes Armed Forces Day, May 17, 1958

OUR MILLIONTH FILTER SHIPPED THIS YEAR...

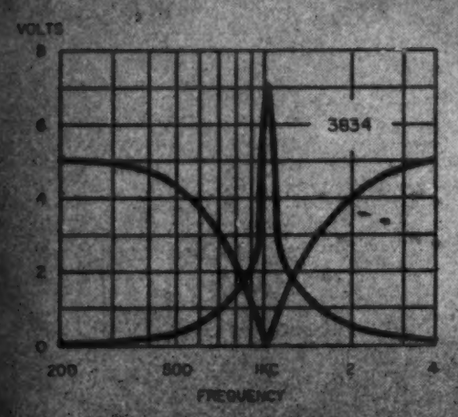
FILTERS
FOR EVERY APPLICATION

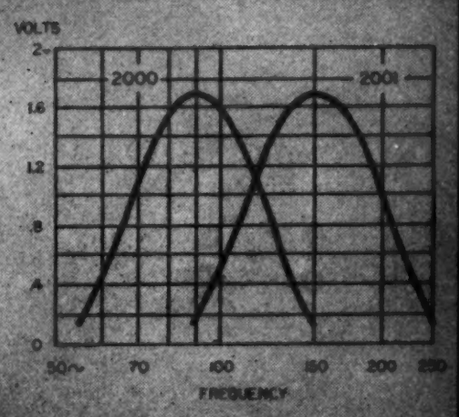


Dimensions:
(4682A) 1½ x 2 x 4"



Dimensions:
(3834) 1¼ x 1¾ x 2-3/16".
(2000, 1) 1¼ x 1¾ x 1⅝".





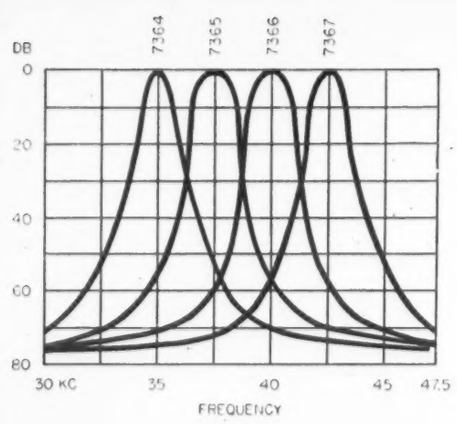
AIRCRAFT FILTERS

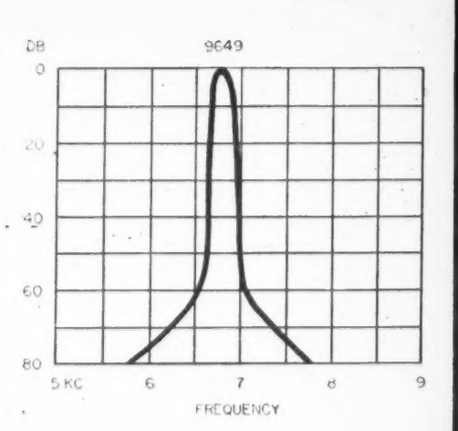
UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

CARRIER FILTERS

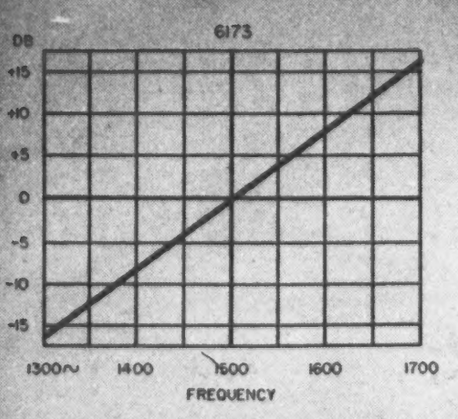
A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.

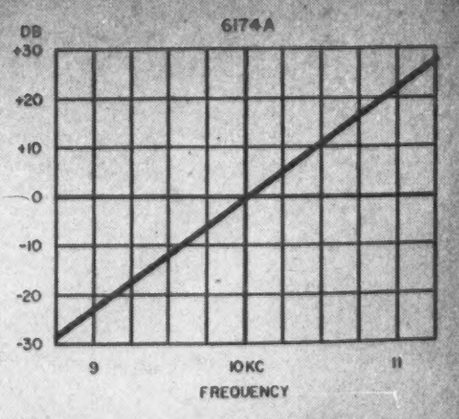


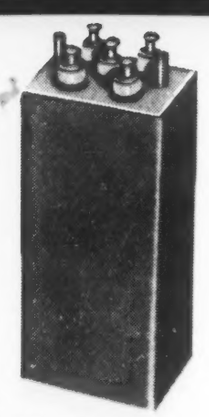


DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.







Dimensions:
(6173) 1-1/16 x 1⅜ x 3".
(6174A) 1 x 1¼ x 2¼".

For full data on stock UTC transformers, reactors, filters, and high Q coils, write for Catalog A.

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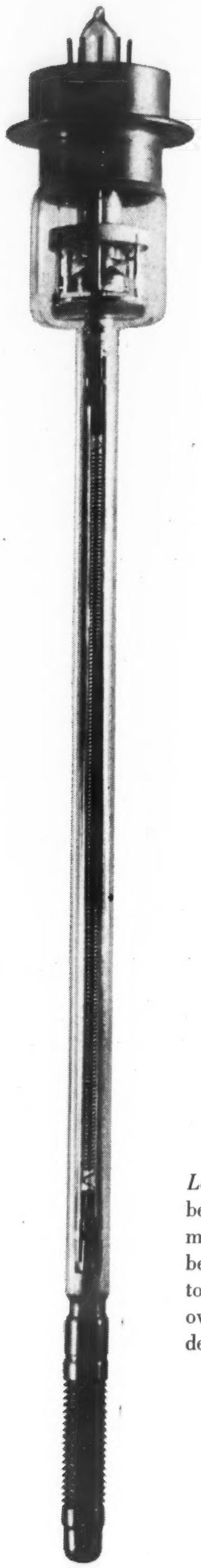


A GREAT AMPLIFIER TUBE IS PERFECTED FOR TELEPHONY

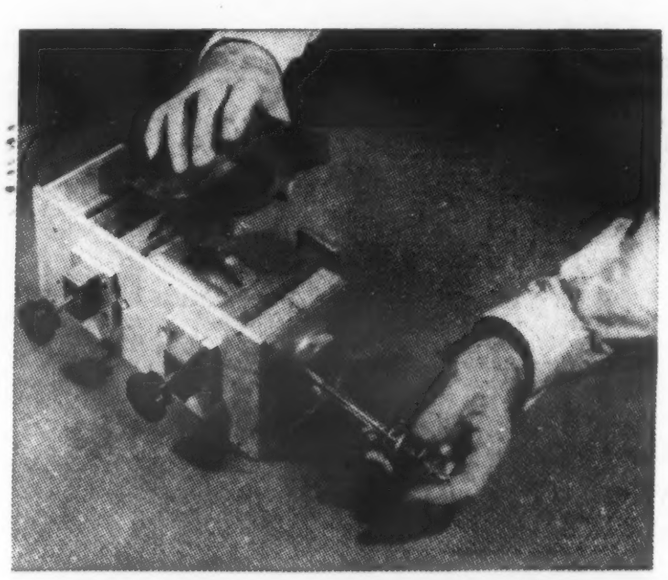
A new transcontinental microwave system capable of carrying four times as much information as any previous microwave system is under development at Bell Telephone Laboratories. A master key to this development is a new traveling-wave tube of large frequency bandwidth.

The traveling-wave amplifying principle was discovered in England by Dr. Rudolf Kompfner, who is now at Bell Laboratories; the fundamental theory was largely developed by Labs scientist Dr. John Pierce. Subsequently the tube has been utilized in various ways both here and abroad. At the Laboratories it has been perfected to meet the exacting performance standards of long distance telephony. And now for the first time a traveling-wave tube will go into large-scale production for use in our nation's telephone system.

The new amplifier's tremendous bandwidth greatly simplifies the practical problem of operating and maintaining microwave communications. For example, in the proposed transcontinental system, as many as 16 different one-way radio channels will be used to transmit a capacity load of more than 11,000 conversations or 12 television programs and 2500 conversations. Formerly it would have been necessary to tune several amplifier tubes to match each channel. In contrast, a single traveling-wave tube can supply all the amplification needed for a channel. Tubes can be interchanged with only very minor adjustments.

The new amplifier is another example of how Bell Laboratories research creates new devices and new systems for telephony.

Left: A traveling-wave tube. *Right:* Tube being placed in position between the permanent magnets which focus the electron beam. The tube supplies uniform and distortionless amplification of FM signals over a 500 Mc band. It will be used to deliver an output of five watts.



Bell Telephone System

COMMUNICATIONS -- *Half the Battle!*

Will today's communications help win tomorrow's battles? For a good answer, take a look at how the U. S. Army Signal Corps is keeping ahead of the fast-changing techniques of military operations — by providing *tomorrow's* communications systems *today*.

Look, for example, at the Signal Corps' completely miniaturized, all-transistor carrier system for cable or microwave communication in the field. It is fully portable, takes up less than a cubic foot of space, weighs only 65 pounds (compared to 500 for comparable World War II equipment). It provides 4 separate channels, offers highly reliable operation under severe conditions ranging from Arctic cold to tropic sun.

Lenkurt, selected as prime contractor for the development of this carrier, has facilities uniquely oriented to research, development, and precision production for vital defense projects. As a leading specialist in telecommunications, Lenkurt works directly with government agencies and with other manufacturers in providing equipment either "off-the-shelf" or specially designed, to meet the highest standards and most exacting requirements of the military.

For New Facilities Brochure, Department 9-B, 1105 Old County Road, San Carlos, California

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BPA

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Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XII MAY 1958 NUMBER 9

CONTENTS

The Military Potential of Commerce and Industry* 5
The Honorable Walter Williams

What MATS Means to National Defense* 10
Brigadier General A. T. Wilson, USAF

Free Men Against Time 12
Senator Henry M. Jackson

National Aims and Space Power, Part II 17
Major Alexander P. de Seversky

Training the Pentomic Soldier 20
Major Max L. Marshall, USA

Science and Industry in the Next Decade 25
Dr. C. C. Furnas

A Simple Technique for Handling Complex Microwave Circuits 34
Alexander Horvath

Photoprogress 39
Frank Smith

*This feature article represents a continuation of the Stockpile Concept (see the January issue) for 1958, stockpiling vital information for SIGNAL readers.

Special Notice

In the broadcast series, "America on the Go," Alex Dreier, national radio and TV commentator, will salute Armed Forces Communications during a nation-wide radio program on Sunday, May 25, 1958, over NBC's "Monitor." The program will be broadcast at 6:05 p.m. EST over the entire NBC network of nearly 200 stations. Dreier will tell his 9,000,000 listeners of the tremendous accomplishments in communications and electronics. This tribute will tie in with the AFCEA June 4, 5 and 6 Convention and Exhibits at the Sheraton Park Hotel, Washington, D. C. The sponsor of this program is North American Van Lines, Inc., whose world-wide moving headquarters is located at Fort Wayne, Indiana.

DEPARTMENTS

Signalgram 33
Personnel Available 43
AFCEA Group Members Directory 44
AFCEA Chapter Officers Directory 46
Chapter News 48
New Products 56
Items of Interest 60
Books 63
Index to Advertisers 64

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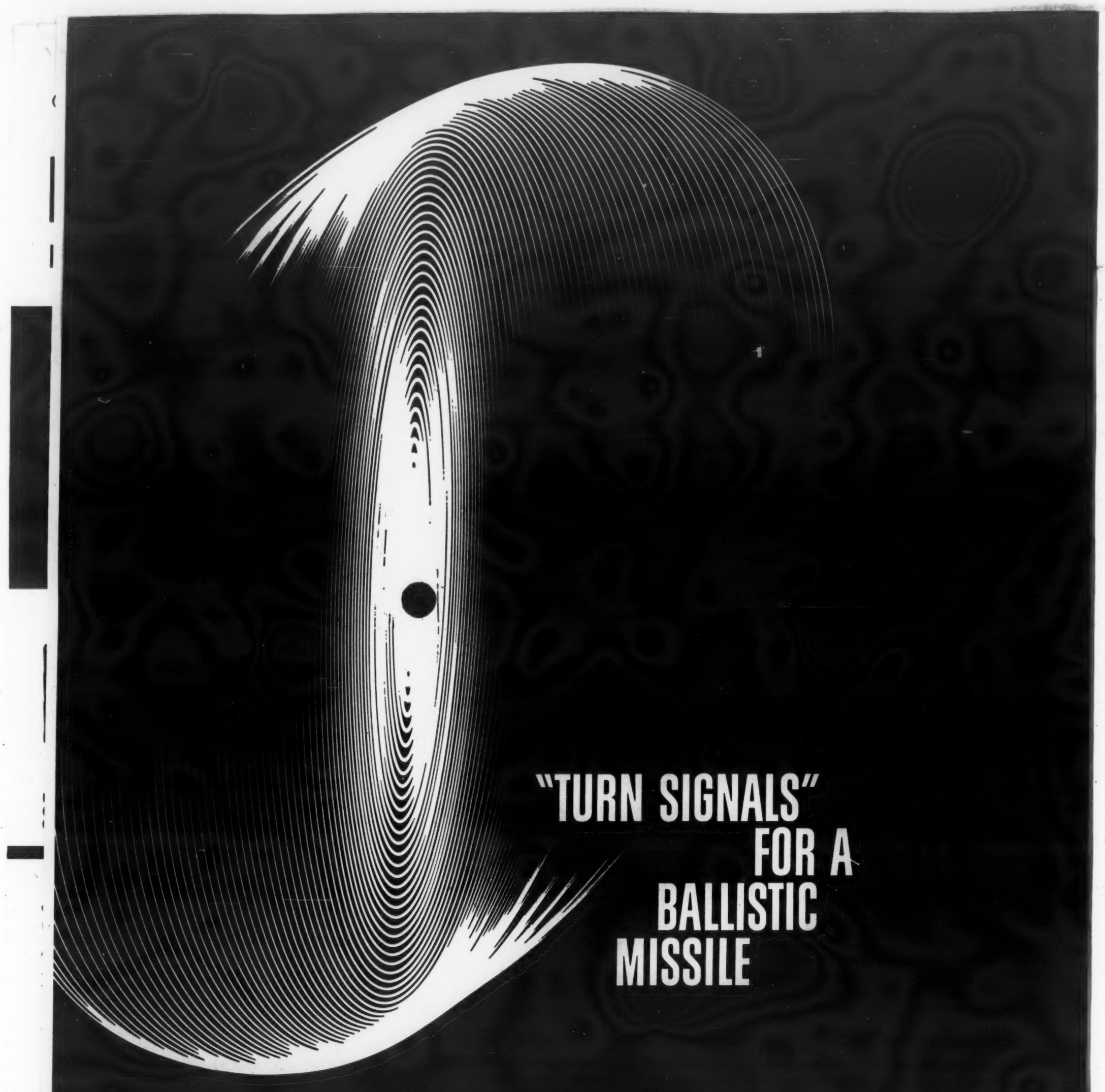

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Important contracts are not new to Burroughs Corporation with its 70 years of demonstrated competence. But it is the recent defense projects that serve best to underscore Burroughs' breadth and complete capability, from research through mass production to actual field installation and service. Burroughs Corporation, 6071 Second Avenue, Detroit 32, Michigan.

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THE FOREMOST NAME IN COMPUTATION

the MILITARY POTENTIAL of commerce and industry

by **THE HONORABLE WALTER WILLIAMS**
Under Secretary of Commerce

THE VIGOR OF U. S. PRODUCTIVE capacity is reflected in the impressive annual increases in the Gross National Product of the Nation. U. S. industry, an "Arsenal of Democracy" in two World Wars and Korea, has kept the Nation ahead in the present "cold war." With its continued success the world may avoid the horrors of a hot war. We may be reasonably sure of freedom from direct attack unless and until an aggressor is certain that the ability of the United States to retaliate will be virtually wiped out with that first blow.

American industrial capacity is a key factor in preventing such a disastrous possibility. World leadership of this Nation is dependent, of course, upon adequate military power. The effectiveness and scope of our military potential must rest, however, upon economic strength, which includes support and development of the economies of less fortunate nations.

Underlying these vital areas of national strength is intellectual leadership. This basic asset not only underlies our military and industrial capacity. It also sets the standard of intrinsic values around which we and other nations can orient our thinking and actions to solve our economic, political and social problems.

Since the war, we have witnessed an unparalleled manifestation of divisive forces throughout the world. This has been especially true in the economic realm. These forces not only exploit such age-old conflicts as those between rich and poor or employer and employee. They also involve fear of commercial exploitation through economic imperialism, slave labor, and the oppression of a vast segment of the world's population. Another seriously divisive influence is the race problem, creating vast areas of ill will throughout the world.

The present conflicting and divided world outlook is forcefully reflected in startling and overwhelming international misunderstanding, bitterness, and strife. Various aspects of this present tense situation are identified by such terms as cold war, war of nerves, undeclared wars, lightning wars, total wars, all-out wars, a war in the making that will have such instruments and powers of destruction as the world has never known.

The 1958 curtain rose upon a year of high drama—an exciting year in which philosophies must be searchingly re-examined, polices formulated, important decisions made and decisive actions taken. We have become accustomed to thinking of our Nation as supreme, a leader, invincible. Now we are challenged by a rival who, within our own lifetimes, has emerged from an almost medieval status to a commanding position. During this period, the rate of progress of our opponent in certain instruments of destruction has been great. We must meet this challenge or accept a position of insecurity, if not inferiority.

While we must maintain the balance of military power, this alone is insufficient as a basis of foreign policy. In this atomic age even small nations can achieve the power of absolute destruction. We may be able to destroy our enemies through military action alone, but they may be able to destroy us at the same time. But when military potential is combined with the economic and industrial power of a free economy, we can make our Nation strong enough to meet or even prevent all attacks of alien forces.

Although to date frustrated in their attempts to solve the problems of disarmament, I hope that eventually all governments will work in concert on the even greater problem of sharing, for peaceful purposes, the material resources of the world. We shall need wisdom and human understanding as well as technical progress. For the adaptations we must make in the immediate future will not be in material things alone, but will involve us emotionally and morally.

President Eisenhower, in his State of the Union Message, sounded the keynote of our spiritual leadership when he said: "In the last analysis there is only one solution to the grim problems that lie ahead. The world must stop the present plunge toward more and more destructive weapons of war, and turn the corner that will start our steps firmly on the path toward lasting peace."

The President outlined various means of cooperation in "works of peace." Among other things he recommended broad cultural and scientific programs and showed clearly that this Nation holds forth the hand of friendship to all peoples. He placed great emphasis on the need for continuance and extension of our mutual security program as an important measure for both our defense and for peace in the world. He was strong in his demand for extension of the Reciprocal Trade Agreements Act—and not just for one year, but for a five-year period. Two-way trade ranks in importance with military preparedness and may be even more important in many areas of the world.

Our free-enterprise economy has produced the highest standard of living ever achieved by man. In 1927 the Gross National Product rose 4.6 percent to $434 billion in current prices.

Our great industrial capacity can support vast defense and atomic energy programs. Actual production as well as capacity has expanded

at a spectacular pace since the beginning of World War II. While projected production schedules are secret, the immense facilities and production know-how of American industry, when given the green light, can start turning out long-range ballistic missiles at a rate dismaying to any potential adversary. And the Atomic Energy Commission indicates an abundant supply of nuclear materials is available for Intermediate Range Ballistic Missile warheads.

Failure to plan adequately for possible emergencies in the two previous world conflicts resulted in serious delays in the conversion and expansion of industry to meet wartime demands. Profiting from this experience, Administration policy emphasizes the need for industrial mobilization planning. In cooperation with the Office of Defense Mobilization, the Department of Commerce, together with most of the other departments and agencies of government, has worked for the past four years in developing industrial mobilization plans.

Over-all national planning encompasses all governmental policies and actions required to assure full utilization of our enormous industrial potential. Plans are being constantly refined to provide up-to-date and continued attention to new situations as they develop. We are alert to developing the best possible methods of orienting our economic activities to assure maximum effectiveness in achieving ultimate victory.

Intelligent mobilization planning requires accurate information on all critical products, services, and facilities. Included in this essential preparedness program are production expansion programming, protective measures against sabotage and espionage, dispersion and other industrial defense activities, post-attack damage assessment and restoration planning, and many other current and planned activities. The Department of Commerce, through the Industry Evaluation Board, continuously identifies and evaluates the manufacturing establishments and service installations and facilities which are of exceptional importance to our national defense.

Defense Measures

Planning for the restoration of industrial production after a massive nuclear attack is carried on by our Business and Defense Services Administration. We are now engaged in a fundamental case study, with ODM support of individual industrial firms, together with their suppliers and customers, with a view to assessing possible bomb-damage and planning adequate defense measures.

Closely related to such mobilization planning is the national economic accounting program of the Office of Business Economics. Most long-range policy decisions of the Federal Government, of large business enterprises, and of many trade associations and labor and agricultural organizations now are formulated in the light of O.B.E.'s national economic accounts, such as the Gross National Product and National Income series. No nation in the world is better equipped than this country with the facts needed for making major national decisions.

The direct challenge now being hurled at the Free World by the Soviets is economic and technological as well as military and political. Our economic policy is and must be the continuous expansion of business, progressively increased production, and the development of additional markets for our products. This must include substantial imports of those foreign-made goods which merge with and strengthen our economy. Over half of our annual merchandise imports consists of crude or semi-developed processed materials. This fact alone points up the essentiality of two-way trade to mutual security and a peaceful world.

The recently-concluded agreement between Moscow and Syria is a decisive step in Soviet long-range planning for penetration of the Middle East. An especially significant feature of this 19-project compact is the Soviet promise to accept Syrian commodities in exchange for economic and military aid. Its aim is clearly to tie Syria's technological future effectively into Soviet methods and equipment.

We must be prepared to meet this economic challenge with the same positive action now manifesting itself in the military sphere. In our secure atmosphere of a free economy we have been prone to underestimate the importance to our country of our relationship with less fortunate peoples. As the world's most prosperous nation we must face up to conditions in a largely have-not world. For the Syrian case demonstrates that Soviet technique is designed to exploit the poverty of of the have-not nations for the cause of world Communism. It can be met by boldly accepting world leadership through enterprising trade and investment policies. The Bureau of Foreign Commerce of the Department of Commerce is providing essential information and services to that end.

Equally important to the over-all potential of commerce and industry is the support provided by Department of Commerce agencies in various technological areas.

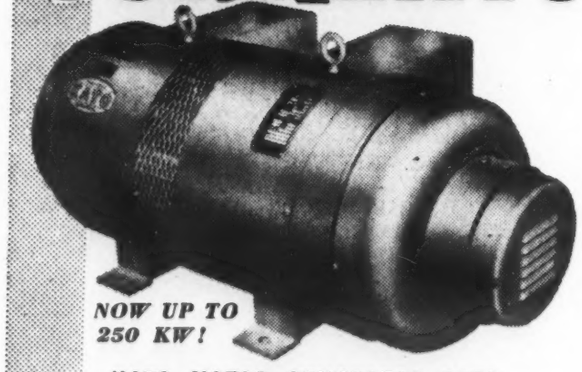
A modern aircraft or missile system includes about one-million individual components. These must be obtained from as many as 500 separate specialty manufacturers. Coordinated production of this magnitude is entirely dependent upon the greatest degree of precision in instruments, gage blocks, and industrial standards calibrated through a careful chain of measurement to the national standards.

The work carried on by the National Bureau of Standards in establishing basic physical references is the essence of mass production upon which the Nation's production capacity must rest. The tremendous specialized instrumentation industry is perhaps the greatest evidence of the importance of measurement to modern technology.

Another important consideration in our national strategic planning is the weather. For more than two years the Weather Bureau has been preparing, twice daily, complete upper-air fallout patterns of all major cities for use by the Federal Civil Defense

(*Continued on page 8*)

Specify KATO 400 CYCLE CURRENT!



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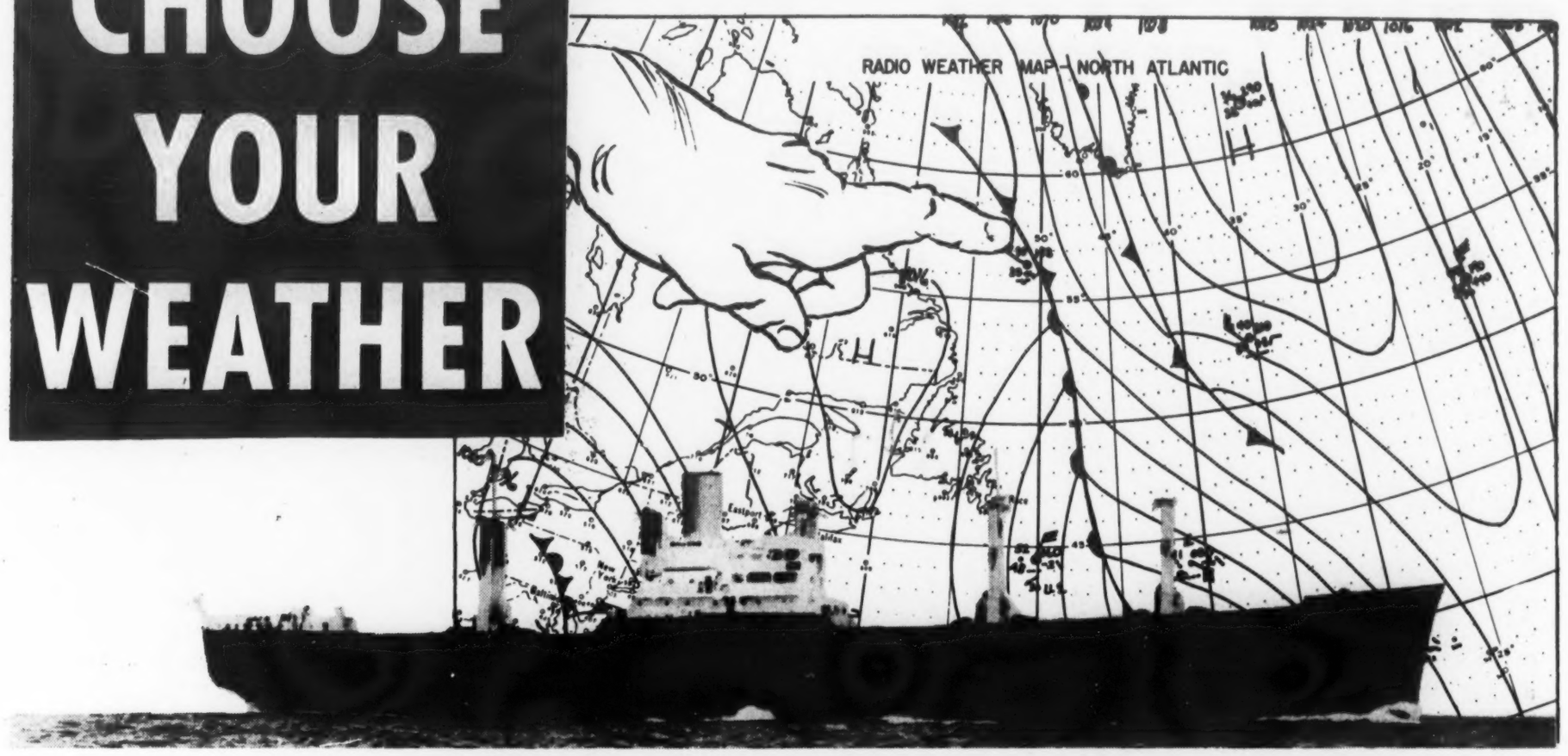
CHOOSE YOUR WEATHER



avoid bad weather losses

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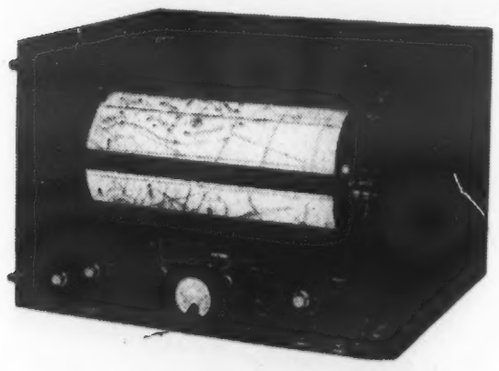
Minimize the hazards of uncertain seas with the new "Sea Conditions" charts regularly transmitted by radio.



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Administration in planning protective actions in the event of nuclear attack. Aviation forecasts are particularly important in weather forecasting for hundreds of domestic and international air routes.

In these times of miraculous scientific advancements many stories are being circulated concerning the possibilities of modifying or controlling the weather. Most of the claims are highly exaggerated but our meteorologists are not overlooking any possibilities and are conducting basic research toward advancing the science and application of meteorology.

Knowledge of all phases of science and invention are, in fact, a part of our contributions to national progress. Our Patent Office is a storehouse of scientific and technical information available to American industry in the solution of technological problems. Those patents having a national interest are referred to the military departments, Atomic Energy Commission and other pertinent agencies for inspection and concurrence before the patent is granted.

America's industrial and economic development requires several types of statistical data which are provided by our Bureau of the Census. The Bureau collects a wealth of detailed information concerning industrial manpower and facilities, raw material supply, and manufacturing output. The censuses of manufactures and mineral industries are taken every fifth year and preparations are now being made to collect this information for 1958.

The Census Bureau also compiles monthly information on the import of strategic materials. The various censuses which we undertake produce data which measure America's industrial capacity, and under emergency conditions, existing data will be updated by new surveys of surviving facilities and manpower.

All of you are familiar with the Coast and Geodetic Survey, which has specific and engineering responsibilities basic to our commerce and industry. Of particular interest to this group is Survey support of the rocket and missile program through applications in the highly sensitive areas of missile guidance and target pinpointing.

Great refinements are now being made in basic geodetic techniques to meet the exacting requirements of the space age in defining precisely inter-continental distances and locations. The historical background of the Bureau in triangulation, gravity, seismological, and geomagnetic investigations provides the Bureau with a unique advantage in contributing basic support in a highly sensitive area important to the Military as well as to the commerce and industry of the Nation.

Transportation Surveys

The Survey is also among the agencies of the Department of Commerce concerned with transportation. The intensive surveys made by the Bureau over the past 150 years provide a vast amount of data essential to marine and air navigation. Hydrographic information is especially significant at this time in underwater navigation. New developments in atomic-powered submarines, and proposals for accelerated production in submarine construction emphasize the importance of accurate underwater data.

American shipping must continually move forward in step with the ever-broadening scope of our trade and commerce. In a very real sense, the American Merchant Marine is the "fourth arm" of American defense. The National Defense Reserve Fleets, maintained by a Maritime Administration, have a defense stockpile of more than 2000 merchant ships. This huge ship reserve is kept in readiness to answer an instant call to arms.

Along with the regular Merchant Marine, this ready reserve gives assurance to our friends and allies of our ability to respond swiftly and effectively should the need arise. The fact that we have the capability of swift action in the field of ocean transport is an effective deterrent to any potential aggressor.

We expect to put into service in 1960 the world's first nuclear propelled merchant ship, capable of sailing 100,000 nautical miles without refueling. Other projects having the highest correlation to the defense potential of the Nation include experiments in gas turbines and in more efficient and economical means of unloading ships.

Our great transportation system, so basic to the industrial capacity of the Nation in peace and war, includes our highways. I am happy to report that we are forging ahead on schedule with President Eisenhower's "Grand Plan" to link our major cities and industrial areas. Our Bureau of Public Roads estimates that by the time that this National System of Interstate and Defense Highways is completed, 100 million registered motor vehicles will be traveling a trillion vehicle miles annually.

Although the interstate system has been highly publicized and has attracted more public interest than the primary, secondary and urban programs, these latter programs are being pushed with equal vigor. We are working with the highway department in each State toward making a final determination of routes to comprise the Interstate System. Studies on a national basis and discussions with the Department of Defense indicate the necessity of adding certain routes of considerable significance to national defense.

The growth in aviation is equally breath-taking, with tremendous effect upon national defense. This growth requires ever-increasing support by the Civil Aeronautics Administration in the operation of air navigation and traffic control systems. Of almost 24-million landings and take-offs annually at airports with CAA-operated traffic control towers, about one in four is of a military nature. We are now engaged in an all-time record program to provide radars and other safety devices for the jet age.

We make a substantial investment in security through our support of military aviation. CAA services are especially essential to missions of the Strategic Air Command, and military training flights. The Secretary of Commerce is specifically delegated authority to prescribe priorities and to make allocations in connection with air transportation facilities. Pursuant to this authority, planning and direction of the mobilization of our civil aviation resources in wartime are carried on by our Defense Air Transportation Administration.

These activities represent industry-government cooperation at its best. All these integral segments of our economy and industrial potential work together to afford us a position of unsurpassed economic strength.

Our past accomplishments and the prospects for the future paint a picture bright with hope not only for the citizens of this Nation but for all peoples of the world. For—as President Eisenhower so eloquently stated in his State of the Union Message—"We will always go the extra mile with anyone on earth if it will bring us nearer a genuine peace." And he concluded with those words which we all pray will prove prophetic: ". . . the future belongs, not to the concept of the regimented atheistic state, but to the people—the God-fearing, peace-loving people of all the world."

DEW LINE'S VOICE

The Distant Early Warning Line needs more than advanced radar networks to do its job of guarding the northern reaches of the North American continent. It must be capable of sounding the alarm to continental defense centers unfailingly at any time should intruding aircraft be detected—even in the face of radio disturbances associated with the Arctic. A technological breakthrough in radio communication—Transhorizon scatter—provided the required reliability. Collins, a pioneer in Transhorizon, was given the assignment to supply the radio communication equipment by Western Electric Company, Inc., which directed the gigantic task of building the DEW Line.

UHF tropospheric scatter is used for lateral communication between DEW Line stations, tying together an advanced telephone system for coordinating the parts of the 3,000-mile electronic wall. VHF ionospheric scatter, with its longer range, provides rearward communication to defense centers. The equipment used on the DEW Line for conventional HF and ground-to-air VHF communication is also Collins.

DEW Line is another of the instances where Collins' engineering ability and experience have been called upon for advanced, reliable communication systems to serve in all parts of the world.

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WHAT MATS MEANS TO NATIONAL DEFENSE

by

Brig. Gen. A. T. Wilson, USAF

Deputy Chief of Staff,

Operations, Military Air

Transport Service

SINCE THE MILITARY AIR Transport Service is relatively new, I am pleased to have the opportunity to discuss this command which was in place at Scott Air Force Base on 15 January 1958.

Coincidentally, in 1940 I came to Scott Field as a member of the communications school that was being transferred from Chanute. Now, once again, seventeen years later, I am coming back to Scott as the base mission changes from one of communications training to that of an operational command. Scott can be proud of the technical schools' achievement in the seventeen years it has been in business. I know that in the two years I was Director of Training, 1942 - 1944, approximately 77,000 combat-ready radio operators were graduated from the school and distributed to hundreds of combat units both in the States and overseas.

The public generally understands the mission of the Strategic Air Command, the mission of the Air Defense Command, and the mission of the Tactical Air Command, but I find that a great many do not understand MATS and how it fits into the military structure of our Armed Forces. So, briefly I want to give a bird's-eye view of what we do and what MATS means to our national defense.

In World Wars I and II, we were indeed fortunate to be allowed many weeks and months to mobilize, train, and move our people into combat areas overseas. Should World War III ever occur, the enemy will not permit this courtesy again. The tremendous advancement of weapons systems, where unbelievable devastating fire power can bridge the oceans and seek their targets with accuracy, now demands we take advantage of every hour and day after E-Hour to deploy our Forces and to provide immediate logistic support. The fastest and most effective means to move our people and weapons and the supplies to forward areas is by air transport and this is the job of MATS.

MATS must maintain in being a military air transport system and exercise daily in order that airlift can be instantly ready should a national emergency arise. Time is of the essence in modern war or in the limited "brush-fire type" disturbances that can arise anywhere at any time. Too little—too late, for lack of airlift, is inexcusable and we in MATS appreciate the profound responsibility that is ours. This is what MATS means to national defense.

Now, just what is MATS? It is a world-wide command of some 120,000 Air Force, Navy, and civilian personnel who fly and maintain military transports; who operate the Air Force's world-wide communications and navigational aids system; who provide a world-wide Air Weather Service; who have deployed and readied a world-wide Air Rescue Service, and who are responsible through the Air Photographic and Charting Service for aerial mapping and photography to meet the peculiar needs of air operations. Just for good measure, we are also responsible for the air defense of Iceland. Ours is a twenty-four hour a day, 365 day a year operation, for keeping the world-wide air routes open and ready. The importance of our services in peace as well as war can be appreciated when it is realized that over 12% of the entire Air Force is in MATS.

At present there are three transport divisions operating some 400 four-engine transports. The Atlantic Division with headquarters at McGuire Air Force Base on the East Coast is responsible for the Arctic regions in the northeast, the entire mid-Atlantic area, the United Kingdom, and Europe. Continental Division with headquarters at Kelly Air Force Base is responsible for the Caribbean and all missions to South America, as well as serving North Africa and the Middle East. The Continental Division also operates a domestic air evacuation service with some 36 aircraft of the Convair type. This is a rather unique operation in that they serve over 300 hospitals in the United States and perform certain missions to overseas areas, particularly those involving polio. This is because we have the equipment that can be placed in these aircraft to accommodate polio patients. The Pacific Division with headquarters at Parks Air Force Base, California, is responsible for Alaska, the entire Pacific, and the Far East as far as Dhahran in Saudi Arabia. At present we are serving approximately 71 channels moving cargo, personnel, and mail. Each month we airlift approximately 12,000 tons of cargo and carry about 50,000 passengers. Each month we complete a total of 2,100 ocean crossings, flying approximately 56,000 flying hours. At any one instance during the day there are approximately 70 MATS transports in the air. Every 3.6 minutes a MATS transport either takes off or lands somewhere and so far this calendar year we have set an all-time fly-safe record with a rate of .8 accidents for each 100,000 hours flown. When it is considered that we fly daily into the Arctic and through all kinds of weather, this is a remarkable record of which we are very proud.

Each month we are involved in some 150 special trips. These consist primarily of airlift support for special Strategic Air Command movements and exercises. This we consider important since it exercises, in part, operations we would be expected to perform in time of war. From time to time we are called upon for airlift in minor emergencies; for example, more recently MATS moved the initial contingents of the UN police force from Colombia and Brazil in South America to Italy and from India to Italy. This necessitated deploying our transports half way around the world to pick up these Forces and move them into position. In this operation which occurred just a year ago, we were delayed on only one trip. In December 1956, MATS conducted Operation Safe Haven which airlifted 9,700 Hungarians from Munich, Germany, to McGuire Air Force Base, New Jersey. This

(Continued on page 24)

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The Kleinschmidt teletypewriter set sends teleprinted messages from tape at speeds up to 100 words per minute.
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Senator Henry M. Jackson

Having had more Congressional experience than any legislator his age, Senator Jackson, at 45, has served in the House for 12 years and in the Senate for 5 years. Senator Jackson (D-Wash.) serves on the following major committees in the Senate: Armed Services, Government Operations, Interior and Insular Affairs, and the Joint Committee on Atomic Energy. Senator Jackson also is Chairman of a Special NATO Committee on Scientific and Technical Manpower. In 1956, he toured the Soviet Union for two months and visited the Middle East.

FOR THE PAST FEW MONTHS, we have been engaged in a great re-examination of our national course and destiny. Fortunately, this reappraisal has for the most part been kept out of the partisan political arena. This is as it must be. In fact, no one party and no one person has had a monopoly of wisdom and foresight.

The decisive question, furthermore, is not what we as a Nation did or failed to do in the past. It is what we as a Nation do, or fail to do, today and tomorrow.

If Sputnik were only one isolated Soviet technical triumph interrupting a long and continuing series of American victories, it would not have been too alarming. But Sputnik is not an isolated incident. It is part of a clearly discernible pattern of ever-growing Soviet achievement in the scientific, technical and military spheres. The harsh meaning of this pattern is simply this: *If events proceed on their present course, we will become a second-class military and political power, while the Soviets become the dominant nation of the world.*

I do not say this is inevitable. But I say this will happen, as relentlessly as day follows night, unless present trends are corrected. These solemn words are not said lightly; they are said because I earnestly believe they accurately describe the prospect now before us. Let me try to explain why I believe this is so, and what I think we can and must do about it.

The ingredients of national military power are well known. They are four in number—land, people, natural resources, and industrial capacity and technology. The Communist world now surpasses our Nation in two, or possibly three, of these categories.

Land: The Communist land mass is six times as large as our own country. People: There are about one billion people in the Red Empire, as against 175 million Americans. Natural Resources: The mineral wealth and raw materials within the Communist Empire are probably more diversified and more abundant than our own. Industrial Capacity and Technology: America now outstrips the Communist world in only one ingredient of military power—our superior industrial might. This has been our trump card in the struggle with the Soviets. Heretofore, our industrial lead, and the superior weapons which this lead made possible, have cancelled out the Communist advantage in land and people.

Furthermore, our system of free world alliances has combined with American industrial supremacy to help offset Communist superiority in land and people. The assets of the free world, when thus joined, have been greater than those of the Communist Empire.

Moscow knows what she must do to acquire preponderant power. Moscow knows how the world balance of power can be tipped decisively against the United States. Moscow knows that if the Soviets can overtake us industrially and at the same time neutralize our allies, the Communist world will have preponderant military and political power as well.

Says Khrushchev: "We do not need a war to ensure the victory of socialism. Peaceful competition itself is enough. . . . One cannot stop the course of history."

When I was visiting Russia in 1956 on behalf of the Senate Armed Services Committee, we went to see the Agricultural and Industrial Fair in Moscow. The first display to which our Communist guide took us was a large chart comparing Soviet and American industrial production. The Soviet line of growth caught up and passed the United States line in the mid-1970s. Our guide declared with confidence: "We will beat you—industrially."

In my talks with ordinary Russians, they repeated the same point: they were making tremendous industrial progress, building new plans, constructing new hydroelectric projects. They proudly showed us the site on the Volga River near Stalingrad where a 2,300,000-kilowatt dam is being built. This dam will produce 300,000 more kilowatts than our own Grand Coulee Dam. The Soviets are known to be building other great dams, one of which will be twice the size of Grand Coulee.

We Americans know we have the most productive economy of all history. It seems to most of us inconceivable that the Soviets can ever equal, let alone surpass, us in science, technology and industry.

Historical Facts

But is this really inconceivable? Before we can give an answer to this question, let us examine the record.

Go back in history with me some thirty years. The year is 1928. Stalin has just announced the first Five-Year Plan. The forced industrialization of the Soviet Union is started. Halfway around the world stands the United States, the undisputed scientific and technological leader of the world. Soviet production is but a tiny fraction of our own—their coal production less than 2% of ours; their petroleum output less than 10% of ours; their steel production likewise less than 10% and their electric power output less than 5% of ours.

Any person predicting in 1928 that, within a generation, the Soviets would be seriously challenging American industrial supremacy would have been regarded as having a loose mind.

But now we know what happened. Albeit at the cost of fearful sacrifices, Soviet industrial production began to soar upward, at an ever-increasing rate. At the same time, the Russian rulers put overriding priority on training more and better scientists and engineers. A new elite was born in the so-called classless society—the community of scientific researchers and technical managers.

Forced savings were imposed upon the groaning Russian people. The production of consumer goods was held to a trickle. Capital goods and armaments began to be produced in torrents.

First in science and engineering, first in heavy industrial expansion, first in armament production—this was the three-part formula which Stalin believed would bring his Communist empire eventual mastery of the world.

After World War II, a few Americans with unusual foresight raised storm warnings about the coming challenge of Soviet science and technology. But their words went largely unheeded. In 1945, after all, we alone possessed the atomic bomb; we alone possessed an economy that had gone through the war unscathed. People talked about the American Century—an era in which our country would play the same dominant role that was played by Great Britain in the 19th century.

But such prophecies were not read by the Soviets. They were too busy—working. While we boasted of our destiny, the indices of Soviet industrial output continued to soar upward at an annual rate roughly twice as great as our own.

In 1949 came the first sledge-hammer blow to American prestige. The first Russian A-bomb was exploded, years ahead of the predicted time. In 1953 another sledge-hammer blow fell—the first Russian H-bomb—only months behind ours. Then blow came upon blow. In 1955, we saw the first Russian long-range jet bomber, once more ahead of schedule. In 1956 the Soviets tested ballistic missiles with a longer range than ours. By 1957, they possessed operational IRBMs, while we did not. And then came Sputnik—with its portentous news of the powerful thrust of Soviet rockets.

Now here is the truly sobering point: Russia still produces less than half as many goods as does our Nation. Yet, despite this existing inferiority in over-all production, the Soviets are ahead in the race for the ICBM; they beat us in the race for the first step into space, and they are swiftly closing the gap in those less important military areas where they still lag behind.

How, despite our over-all industrial lead, has Moscow managed to do so much? The answer is of course clear. The ruthless and single-minded Soviet dictatorship has channeled an enormous proportion of Russia's resources directly and indirectly into the goods of war, and into building the factories and training the brains needed to produce these goods.

Since the Korean armistice, an average of only about 11% of our Gross National Product has been spent for national security; the comparable figure for the Soviets approaches 20%. During the past five years, an average of only 18% of our gross national income has been plowed back into capital formation; the corresponding figure for Russia has been about 35%.

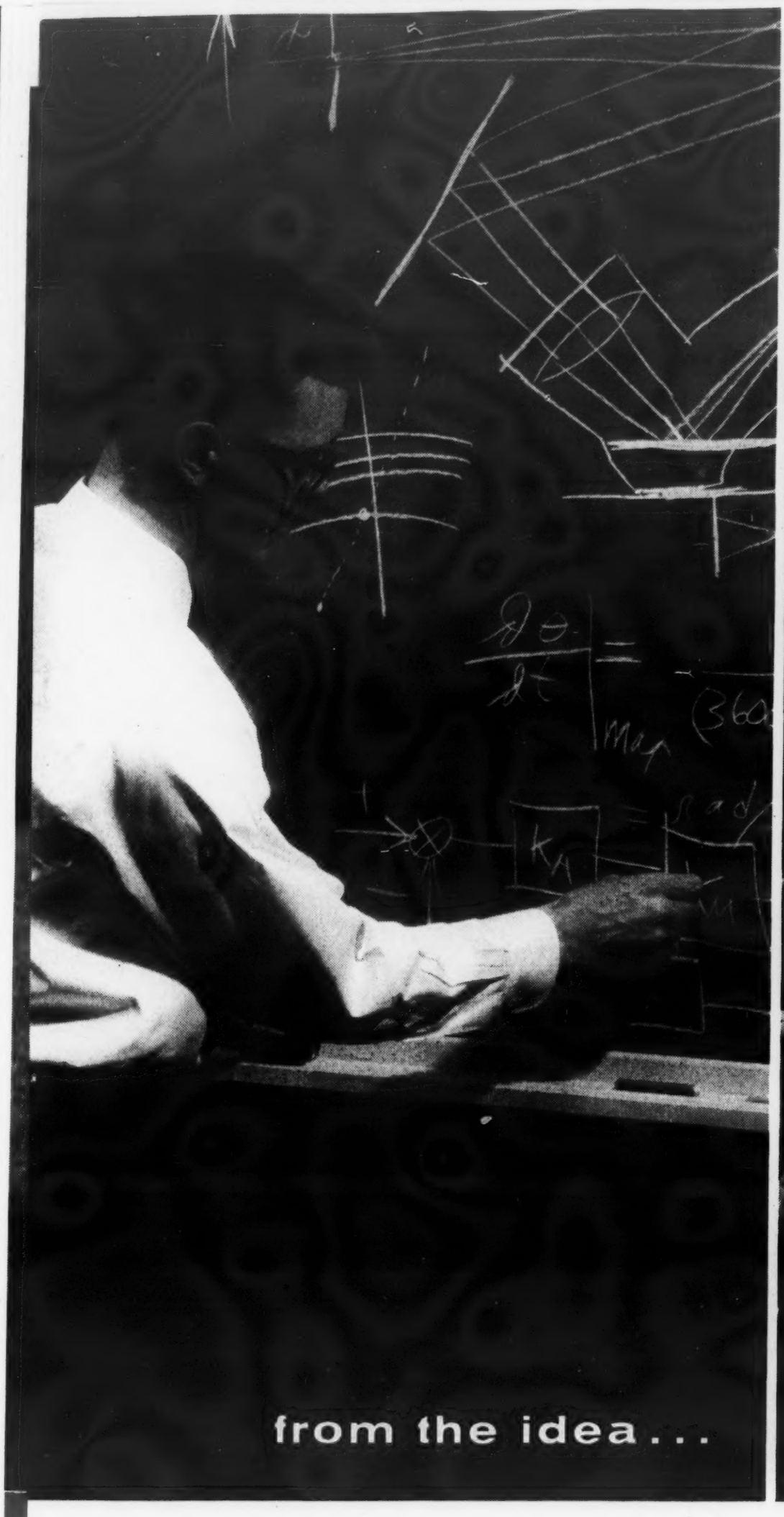
Today engineering degrees are being awarded in Russia at more than twice the rate in this country. In 1956, when I visited a high school in Alma Ata in Soviet Central Asia, I asked the principal what subjects he would emphasize that year. He replied: "Science training—in mathematics, chemistry, and physics—according to the decision of the 20th Communist Party Congress." At the University of Moscow with 21,000 students, 16,000 were enrolled in the sciences and only 5,000 in the humanities.

Yes, it is true that the picture on Russian television screens is smaller and less bright than on our own. It is true that Ivan Ivanovitch, if he has an automobile at all, drives one which lags ten years behind American cars in design and performance. It is true that Russian housing is grossly substandard when compared to our own. But all our television sets, all our automobiles, and all our fine homes will not long comfort us if we fall behind Russia in the competition for world military and political leadership.

The past is prologue. We have no good reason to think that the forward surge of Soviet science and technology will now suddenly be slowed. On the contrary, all indications point the other way. For thirty years, the Soviets have patiently planted the "seed corn" of basic research. Only now is this effort really beginning to pay off in applied technology.

Whereas in 1928 Soviet coal production was only 2% of ours, by 1957 it was about equal to ours. In 1928 their petroleum output was only 10% of ours; by 1957 it had grown to 26%. In 1928 their steel production was less than 10% of ours; by 1957 it was up to 50%. In 1928 their electric power output was less than 5% of ours; by 1957 it had risen to 29%.

Nor have we any reason to expect a reversal of past Soviet emphasis on heavy industry and arms production. In this respect, the present Soviet leaders are no different from Stalin. The publicly stated goal of Mr. Khrushchev



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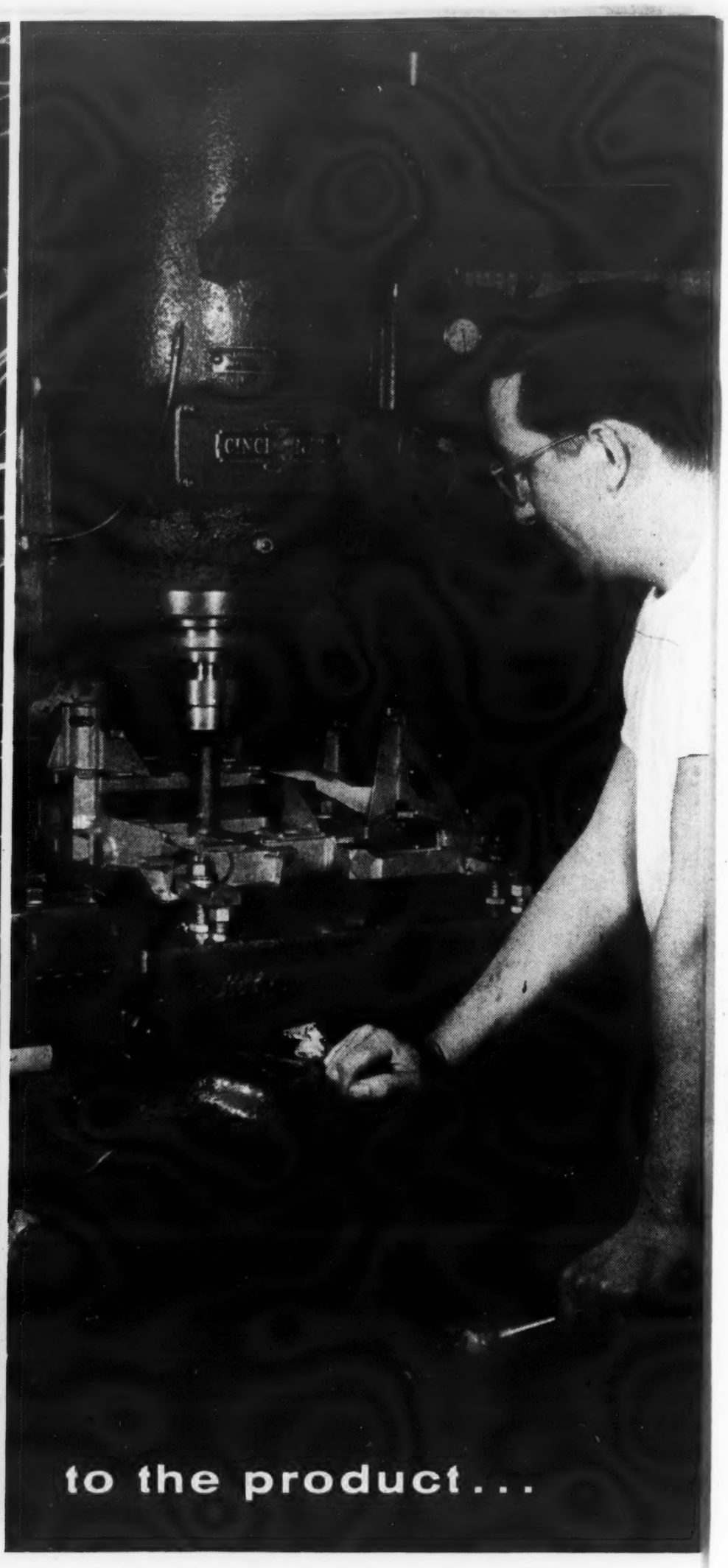

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is for the Soviet Union to overtake the United States industrially within fifteen years.

In fact, as Russia's over-all productivity increases, more and more goods will be available. Soviet leaders can thus meet the minimum demands of the civilian economy and they can offer goods for export, without making real inroads into first-priority items.

The military situation today is grave enough, but the true gravity of our problem does not become apparent until we project into the future the present lines of Soviet and American industrial growth. Here is what such a projection shows: It shows an inexorable closing of the gap between the total industrial output of our Nation and the Soviet Union—a closing in favor of the Soviets.

This is not simply the projection I saw on the chart at the Moscow Fair. Even our objective American economists who follow Soviet developments look at the trend lines and they cannot avoid the conclusion that if present relative rates of growth continue—roughly 6% for Russia and 3% for us—some two decades hence Soviet gross industrial output will surpass ours.

I might point out that actually over the last year our economy has not grown at all. It has in fact moved backwards.

A projection of the present trends also shows our defense expenditures, relative to those of the Soviet Union, becoming smaller and smaller each year. It shows that, within the next decade, a continuation of current trends will give Moscow a commanding and decisive military lead over the United States.

This is strong medicine, I know. Yet nothing whatsoever guarantees that we can keep indefinitely the preeminent position in world affairs which has been ours in the first half of this century. All history is the story of great nations which had their day and ceased to be. The laws of historical growth and decline are still operating. World leadership is not an automatic American right. We will earn it, or we will lose it. Today, we risk losing it.

The starting point for a program of national renaissance must be found in humility. We need less talking, and more doing. We need fewer cold war words, and more cold war acts.

Here is an example of what I mean: The defense budget now before the country. Supposedly, the '59 budget represents a bold, new response to Sputnik and to the over-all challenge of Soviet imperialism. It has been described in such terms as "the first space age budget." Actually, however, our defense budget for the coming year differs scarcely at all from that of last year, and the year before that.

In 1957 actual defense expenditures were $38.4 billion. In 1958 estimated expenditures were $38.9 billion. For 1959 estimated defense expenditures are $39.8 billion.

The increase since Sputnik is only $900 million, and this is mainly for increases in pay and airports. What small increase there is for the missile program is fully offset by curtailment in other military hardware.

Considering the increase in salary expenditures and the rise in prices, the proposed '59 budget actually means a reduction both in armed strength and procurement.

Something is clearly wrong. Either we do not now have a crisis in national defense, or else we do not have a budget meeting that crisis head on. We cannot have it both ways; it is one or the other.

I do not claim that a stepped-up defense effort by itself will contain the Soviet threat. It will not. We face a total threat, extending over a world-wide military, political, economic and cultural front.

I do not claim that there is any single program which, if adopted by the Administration and supported by the Congress, will dramatically halt the relative decline of American power. There is no such single program. The tide of Soviet power has been surging forward for thirty years; it will not be suddenly reversed in 30 weeks or 30 months.

I do not claim that government action is by itself sufficient. It is not. We require a truly national response, enlisting the talents, the ideas, the energies, and the devotion of all Americans. I will go further. Our grand objective must be no less than this: A total free world answer to the total threat of the slave world.

Here are the items which I believe must make up the *minimum* of such a total program for free world survival.

● *First, we should increase our defense budget for the coming fiscal year by between 4 and 5 billion dollars over and above the budget now before the Congress.* This is the least we should do to maintain the free-world deterrent to war. This is the minimum increase needed to stay alive.

The Strategic Air Command is the only deterrent, retaliatory striking force we have on hand. Yet the record contains impressive and uncontradicted evidence that our position in manned bombers is seriously deficient.

Additional funds are required to purchase more B-52s, B-58s and supporting KC-135 tankers that we urgently need to fill the gap until our missiles can match Russian missiles. Ultimately, manned bombers will supplement ballistic missiles, but they cannot supplement missiles we do not have.

Also, increased funds are needed to speed the crucial dispersal of our Strategic Air Command; to build as quickly as possible an early warning system against Soviet missiles; to hasten the production schedules of our IRBMs and our ICBMs, and to make a real start at building a retaliatory striking force of ballistic missile submarines.

While the greatest threat we face is all-out Soviet attack, this is not the most likely threat, today. Moscow probably prefers to inherit the world, if it can, rather than obliterate it. Our most likely immediate military danger is the limited Soviet thrust carefully calculated not to arouse this country to a showdown.

This being the probable Soviet tactic, we require fast-hitting modern mobile forces to deter local wars and to keep them from getting out of hand. We need to restore the strength of our Army to a minimum of 18 active divisions. This is necessary because we do not have a truly ready combat reserve. In addition, we must make the Pentomic divisions really Pentomic, by speeding up the supply of modern equipment. And we must give the Reserve Forces Program steady support.

● *Second, we should make it a goal of national policy to increase substantially the rate of our industrial growth and technological development.*

This is the only way we will get the additional weapons we need to keep us free, the economic tools we need to help keep our allies free, and the consumer goods we need for our well-being. We can have all three if we work hard enough.

Ours is a dynamic economy. We have the precious gift of freedom. We have enjoyed more material abundance than any society ever known to history. It is plain nonsense to say that we have now reached the limit of the rate at which our economy can grow. The true limiting factors do not lie in our factories, on our farms, or in our industries. The true barriers lie in our minds and in our wills.

Today, across the length and breadth of our land,

hundreds of thousands of skilled workers engaged in vital defense projects are losing their jobs. The cost of this unemployment can no longer be measured purely in social and economic terms—in terms of foreclosures, interrupted careers and bankruptcies. The cost must be measured in political and military terms as well. It is to me unthinkable that we should now let our human and material resources remain idle, at a time when the factories of our adversaries are running full blast, 24 hours a day, and 7 days a week.

● *Third, we should initiate a vast new domestic program to educate more and better trained talent to fit the mounting number of critical jobs.*

The discovery of a single scientific genius can contribute more to man's prosperity than the discovery of some vast new body of iron ore. And likewise the discovery of one genius can now upset the military balance of power.

Yet this country squanders much of its talent. About 200,000 able American high-school students who could profit by college do not even go to college. As many as 100,000 to 150,000 might have gone to college had adequate financial support been offered them.

This is no time to quarrel over the respective roles of Federal, state and local authorities in meeting the education crisis. Those with responsibility at each level should do what they can best do to help.

Moreover, new programs should not be limited to teachers and students in science and mathematics. We need more gifted, highly trained and experienced personnel in all fields, including diplomacy—and politics.

I hope Congress will soon pass the bill which would give the country a constructive start on a strong program of scholarships and loans to students, aids to teacher training, help in improving vital teaching facilities, and encouragement to language study.

● *Fourth, we should promptly establish a National New Projects Laboratory under civilian direction, and responsible to the Office of the President.* This is one way to immediately make better use of science for national progress and survival.

We have been staggering along with incredibly inefficient arrangements for using science in the public interest. Efforts of scientists now engaged in the defense program are so fragmented and misdirected that we fail to concentrate on the problems basic to vital breakthroughs.

Our best scientists have no one central place to go to exchange ideas about critical problems and to examine and test possible approaches to them.

Today, brilliant men and women are lost to the national effort because they see no place where they can devote their energies to the most significant questions.

It is time we provided them with such a place—a National Laboratory under civilian leadership. The new Laboratory should be organized to lend support and assistance both to the operation presently directed by Dr. Killian and to the National Security Council. The Director of the new Laboratory should report to the President.

● *Fifth, we should rivet the NATO alliance by rapidly implementing a full-scale program of scientific cooperation.*

Western Europe, standing by itself, cannot survive and flourish. And America standing by itself cannot survive and flourish. But Western Europe and America, joined together as they are in the North Atlantic Treaty Organization, can face up to the Soviet Union.

The time has come to make NATO far more than a military alliance. It should become a scientific, economic and cultural alliance, as well.

I believe the people of the Atlantic Community will make the needed effort for survival if their enthusiasms are engaged in great undertakings—if they feel they are building something, not simply defending something.

Improving the state of science is such a common cause, if we will only make it so. Through better science, free peoples can advance not only their security but their prosperity.

Since 1956 I have served as Chairman of a Special NATO Parliamentary Conference Committee on Scientific and Technical Personnel. At the NATO Parliamentary Conference this fall, unanimous approval was given to our Committee's program to improve the training and utilization of scientists and engineers in the Atlantic Community.

I hope the key projects in our Report will be speedily implemented by the NATO Council. I also hope this year will see notable progress in lowering the barriers to exchange of information in the NATO Community. It is foolish and self-defeating to withhold from our friends what our Russian adversary already knows.

I am sure the American people are wondering where this all leads—where will all-out competition with the Soviet adversary take us? Will we end up in bankruptcy or in disaster?

In answer to that question, I believe that if we outperform the Soviets, we will outlive them. If we respond to the Soviet challenge on all fronts—military, political, economic and cultural—we will see a stronger and better America and a stronger and a better free world. We will accomplish things we would never accomplish otherwise. We will have to cooperate with our allies on a scale far surpassing the past.

I do not share the despair of some of our calamity-mongers. On the contrary, our engagement in this competition can bring out the best in all of us and in our allies. Whatever our vocation or our calling, each of us has his work cut out for him.

Maybe the Russians do not realize this, but forcing this competition upon us, as they are, they give us the historic chance to prove the advantages and power of freedom.

Indeed, it is not impossible that Soviet leaders will destroy themselves. The Kremlin confronts a dilemma. To accomplish and maintain industrial growth, Soviet masters must allow some independent thought. In particular, they must have capable scientists and engineers. They must educate their people to think. Scientific education breeds the logical and inquiring mind. But this in turn spreads doubt and uncertainty about Communist ideology and discipline. Moreover, technological effort can only be sustained if some freedom is given to those who carry forward the creative work.

This is the Soviet dilemma: Soviet scientific and technological effort may sow the seeds of Communist political ferment. However, we cannot take too much comfort from the prospect for internal difficulty in Russia. Dictators have a way of overcoming internal dissension by generating troubles abroad.

In conclusion, we know there are dangers ahead. But beyond the great dangers lies great opportunity—on earth, and in space. In the words of Theodore Roosevelt—whose 100th anniversary we honor this year—"We see, across the dangers, the great future . . . and we rejoice as a giant refreshed, as a strong man, girt for the race. . . . The greatest victories are yet to be won, the greatest deeds yet to be done. . . . There are in store for our people, and for the causes we uphold, grander triumphs than have ever yet been scored."

part II

NATIONAL AIMS and SPACE POWER

Part I of Major de Seversky's article appeared in the April issue of SIGNAL.

by Major Alexander P. de Seversky

SYNOPSIS—PART I

Our most precious defense against the Communist menace is our native scientific brainpower which, Maj. de Seversky warns in Part I, we must delegate with realistic foresight. He concluded with urging that we not waste such talent, dividing it into the outmoded strategic pattern of 3 separate Services while the advantages of an entirely new technology dictate the need for a new and unprecedented strategy.

THE EXCUSE FOR our current profligate strategy, which calls for building everything and anything which comes to mind, is that we must be prepared to fight limited wars with conventional forces all over the world. Let me assure you that we are not going to fight little wars—that, is, unless we take leave of our strategic senses. Such little wars, whether fought with bayonets or atomic shells and bullets, can never be decisive. Limited wars can be fought only with the consent of the belligerents and, therefore, are bound to end in a stalemate. At best, they are a reconnaissance in force, useful to gain a better knowledge of the enemy's capabilities and his political intentions with the inevitable result of disclosing our own hand. Korea and Suez are proof that limited wars will always end precisely where they are started, the status quo prevailing, unless they explode into a major atomic conflagration. The only difference between a limited war fought with conventional warheads and one fought with nuclear warheads is that in the latter case the small nations we are trying to protect will be even more thoroughly decimated than Korea.

The very same technology that makes a total war between equally matched protagonists suicidal makes limited war futile. Russia has apparently sensed this new power relationship. That is why she stopped inciting Turkey and Syria against each other. She has also demobilized further her conventional forces, diverting that manpower toward increasing her potential for total war and forging the tools of economic competition.

The same progress of technology also recasts NATO's role. To consider NATO's continental balanced forces as a shield for the free world is no longer militarily sound. They are a force in being that acts as a mustard plaster applied to the Russian Bear's anatomy. Their real value is to divide Russian military potential so the Soviets cannot concentrate their entire resources on the destruction of America.

Russia has been in production of IRBMs for nearly two years. These are already operational, and she has them in great quantity. Every base and every strategic NATO point on the Eurasian continent is already zeroed by these missiles and could be wiped out instantaneously and simultaneously. Such an attack would be followed by a wave of nuclear-weapon-bearing, supersonic jet aircraft. Therefore, NATO's survival is guaranteed only by the deterrent power of our Strategic Air Command, our Sword of Damocles, complemented by the British bomber command. Thus, the true shield is not the continental NATO force but the United States Continental Air Defense, which makes it difficult for the enemy to impair our capacity to unsheath the sword. The western allies must understand that anything that weakens our shield and blunts our sword must be ruled out. If the NATO forces are maintained at our expense, we are compelled to divide *our* over-all potential just as much as Russia. And, because of our geographical disadvantage and our limited manpower, such a division could prove fatal.

If NATO is to contribute to the strength of the free world, our friends overseas must generate their own forces and weapons primarily by their own effort. Only then can the western alliance achieve superiority over the Communist bloc.

I find comfort in the fact that the British have recently also become aware of the new power relationship. This is evidenced by their statement this past February that they will retaliate with nuclear strategic weapons even if the Russians should attack with conventional forces only.

With all these facts before us, what must our course be? In a total war that can be resolved by a small quantity of multi-megaton weapons, the effort to overtake Russia in long-range jet aircraft, ballistic missiles or satellites will yield us but little. What we need to do is to equal their capabilities and to extend the stalemate from the surface of the earth into infinity. But such a balance of terror is not an ultimate solution. We cannot live forever in constant dread of nuclear attack.

Fortunately for us, that balance does not have to last forever. There is an opportunity for us to regain the upper hand. Throughout history, the advent of each new weapon seemed at first to provide an unimpeded offensive means for its possessor. But eventually and inevitably an appropriate defense was developed, and the offense-defense balance was restored.

The nuclear warhead is no exception. Its devastating power will ultimately be balanced by the difficulty of its delivery to the target. Each war differs radically from the preceding conflict. World War I was static, character-

ized by trench warfare. World War II on the other hand, with its motorized equipment and air power, was highly dynamic and mobile. The next war will differ from the last by again becoming static—a paradox in view of the fact that it will be fought at hypersonic speeds. The strategic picture will be not unlike that of two immobile fortresses, shooting it out with long-range weapons.

With the ballistic missile an operational reality, the maximum efficiency in offensive power has been reached. By that I mean that the desired destruction of selected targets can be achieved in the minimum of time. Everything beyond that, even including satellites, would become anti-climactic because the surprise element would be eliminated and the time required for attack increased.

As long as destruction is carried through space via a vehicle, we have reached the qualitative apex in offensive power. Any further gain in forces for attack will be purely quantitative. It is only natural, therefore, that the scientific energies and creative resources of the protagonists will be channeled automatically into the defensive effort. The present atomic stalemate is bound to evolve once again into a balance of power in which the destruction of the military force of one side can be accomplished only through a protracted attrition inflicted by the other side. When the offensive capabilities of the belligerents are equal, defense becomes decisive.

In developing this defensive capacity, I maintain that we must be guided by several fundamental assumptions: One—we must recognize that speed *per se* is no longer a defensive feature of offense. No matter how fast a missile streaks through the air or space, it can be stopped. Stop the means of delivery, and it no longer matters what is being carried. The second fundamental to recognize is that, in a short time, the range of detection of air or space vehicles by various scientific means will expand virtually throughout the entire circumference of the globe. The surprise attack will be impossible, unless one aide is fast asleep. This is particularly true with satellites which will be under constant surveillance, not only from the surface of the earth but also from friendly satellites orbiting in formation. Thus, penetration to the targets will depend not on speed and not on surprise, but on the ability to countermeasure the energy impulses of the defense.

The intercontinental ballistic missile is sure to be taken in stride. True, a future ICBM could be endowed with built-in electronic countermeasures. It could also possess space-borne rocket power enabling it to deviate from the original trajectory. But the anti-missile missile will also become more sophisticated. And it is a moot question whether this new offense system will be decisive and economically sound.

Once we reach that stage, it will not be a physiological or technological, but a purely tactical decision whether a robot or a human mind must guide the vehicle. In general, robots are too logical. Their reaction is predictable; they are easier to intercept. It will take, as always, human intuition and power of choice to baffle and outwit the defense. That is why I am convinced that, for any precipitant time, the hypersonic, manned vehicle will be the decisive weapon in any future war.

It is true that a robot can be perfected to duplicate the reactions of the human brain. But such a device will be disproportionately complicated and costly. That is why I maintain that the true push-button war, though a scientific possibility, is an economic absurdity.

Although we have surrendered the leadership in some vital areas of national defense by default, fate is still patient and kind to us. Once we reach the stage of relative balance between offense and defense, our country is uniquely equipped to tip the scales in our favor. I have always been convinced of this.

Electronic Right of Way

Although Russia has made vast technological advances, its standard of living has not improved appreciably. On the other hand, the United States has greatly expanded its telephone, telegraph, ticker tape, teletype and microwave facilities—to mention only a few. This highly efficient communications web—the indispensable ingredient of an effective offense, and particularly defense, complex—is already in existence. Representing hundreds of billions in investment, it is the product of our free enterprise and industrial civilization. It would be a Gargantuan task for any government, no matter how autocratic, to create a similar complex, even with slave labor, and have it operational by the time of maximum danger three years from now.

Don't misunderstand me. I do not advocate an electronic Maginot Line, nor do I advocate defense strategy, because the military principle that only offense can win a war is as true today as it has been through the ages.

What I am trying to clarify is that defense, in the modern context, means an offensive action to intercept the enemy by planes, missiles and space vehicles the moment he is airborne, 5,000 miles away. This defense must possess superior counter-countermeasures to decimate the enemy's attacking force. Likewise, the *offense* will have to fight its way to the target the moment it is airborne for attack. It must possess superior countermeasures to neutralize the energy impulses of the defense. Both offense and defense are an integral part of the overall battle for the electronic right of way, and command of the air and space above.

New Weapons Transcend All Services

We must implement these forces and acquire the necessary electronic combat power, even if we have cut everything else to the bone.

Now, what sort of a defense establishment must we have in order to create a strategy attuned to the technology of our times. We must recognize that the present defense establishment is a product of World War II mentality. It presupposes that any future war will be fought with the same methods of balanced forces strategy that were used in the last conflict. The Unification Act of 1947, as amended in 1949, freezes for all time the roles and missions performed by our Armed Forces in the last war. No wonder, therefore, it has been stated: "The advent of revolutionary new devices . . . creates new difficulties reminiscent of those attending the advent of the aeroplane half a century ago. Some of the important new weapons which technology has produced do not fit into any existing service pattern. They cut across all Services, involve all Services, and transcend all Services. . . . In some instances they defy classification according to the branch of Service." I simply fail to see any such extraordinary complication. It is true that the aeroplane did create new difficulties in the defense area half a century ago because it transformed the space above the surface of the earth into the most efficient medium for carrying destruction to the enemy.

The Air Force was created to exploit this third dimension, as another arm of our national defense. Since then, man has flown four times faster than a bullet, faster than a 16-inch shell and faster than some ballistic missiles. With rocket propulsion, the weapons of air power no longer depend on the atmosphere for sustenance and propulsion and are, in fact, space vehicles. The sky is no longer the limit. There is no actual ceiling to the atmosphere; it does not end abruptly at some layer

beyond which outer space exists. One fades into the other gradually over hundreds of miles of altitude. Air power is space power. They are synonymous.

If the new weapons do transcend all Services, it is not because of their inherent military characteristics, but because they have been parcelled out arbitrarily among three departments. The Navy was assigned to handle the Vanguard project. The Army was entrusted with the development of the Intermediate Range Ballistic Missile. Although vested primarily with land and sea warfare, these Services have naturally made a valuable contribution to the conquest of space. But unless we reorganize our defense establishment, we are bound to end up in military absurdity. The space around our planet will be infested with the silver sputniks of the Air Force, the golden sputniks of the Navy and the khaki sputniks of the Army, all orbiting in sundry directions under the control of the heads of three separate departments.

One Force—One Command

In order for new weapons to fulfill their purpose, they must be the product of a definite strategic concept, backed by the ground support of dedicated men who possess the necessary military and technological skill to carry out the mission. They must be developed under the military supervision for the Military. Regardless whether a ballistic missile is viewed as a supersonic vehicle of the Air Force or simply as long-range artillery, the fact remains that all these vehicles—ballistic or guided, manned or unmanned, whether for offense or defense, maneuverable or orbital—intermingle in the same space. The air ocean and its endless outer space extension are one and indivisible, and should be controlled by a single, homogeneous force under a single command.

The appointment of one administrator on top of another with extraordinary powers, or creation of special agencies to develop these strategic weapons, will not solve the problem. We had difficulties with three separate Services headed by one Secretary of Defense. How confusing it will be with three Services working under half a dozen of what amount to equally powerful Secretaries.

No juggling around of our present three Military Services or their respective missions and weapons systems within the framework of the present Unification Act will stave off confusion. The Unification Act must be repealed. The principles upon which it was founded must be repudiated.

The inexorable progress of technology has already made our Navy about 90 per cent Air Force. It wants to project its power through the air and space above by planes and missiles. The Army likewise demands its own independent aviation in order to project its power through the air and space above with planes and missiles.

It is unsound for three separate agencies to fight the same air and space war with the same weapons, namely planes, missiles, supersonic manned vehicles or satellites. In order to implement the strategy of the future, I would like to lay before you the proposition that the time has come to integrate our three Services into one single military force, with one uniform, one promotion list and a single staff. The new establishment must be, for all practical purposes, a congenial Department of Air and Space, in which we have a Bureau of Naval Forces, a Bureau of Ground Forces, and bureaus of other auxiliary units.

The outcries that such a direct line of authority, when the chief of a single staff makes the necessary decisions, smacks of totalitarianism and creates a military Solomon are utterly unwarranted. *Such an organization in a totalitarian state, under the orders of a dictator, is one thing; the same organization, working under the President, the Secretary of Defense and control of the Congress, is quite another.* To deny that in a democracy a single man can have the authority and responsibility to carry out the will of the people is to invite confusion, and that is exactly what we have witnessed in our national Defense Department during the past ten years, primarily because of an unrealistic defense law.

The changes I have recommended cannot, and should not, be expected to come from the Pentagon. They are the duty of our lawmakers. Even though some of our top military leaders individually see their logic and timeliness, they cannot criticize our over-all policies without being censured.

There is only one source from which the necessary changes can come, and that is from the American people, bringing pressure on their representatives in Congress. But they cannot act unless they are brought to realize the dangers inherent in our present military system.

In conclusion, I would like to state that there are those to whom the current demands of the Military seem insatiable. They cannot visualize the necessary changes that can give us strength compatible with a sound economy. As a result, there is a tendency to emulate totalitarian practices in various degrees. It has been stated by a government official that we ought to "give up some of our marginal freedoms." I am convinced that he is wrong. To me, it has long been crystal clear that in any modern human conflict, when one nation's total physical and human resources are pitched against another's, the entire populace can act in unison only under the compulsion of total regimentation or under the inspiration of total freedom. Our Nation's trouble today is that we find ourselves to a certain degree half regimented and half free since, among other things, freedom means the right of the people to have access to the facts.

There are certain panicky souls who chide the American people for extravagant living, for riding in "two-toned convertibles." Others recommend that we tighten our belts and reduce our standard of living. These are also dangerous notions. We have no right to demand sacrifices from our people as long as our military effort—through the maintenance of obsolescent forces and duplication—is only about 50 per cent efficient.

We can never demonstrate to the world the superiority of a free society unless we can prove our ability to be invincibly strong and yet maintain the high standard of living from which our strength flows. If, in order to match Russian strength, we have to reduce the American to the state of the Russian peasant or the Chinese coolie, we will have nothing to offer.

Let me repeat again that we are still the greatest industrial nation on earth. We still have the necessary creative brainpower pool to regain world leadership.

But we can never achieve our national aims unless we streamline our defense organization to take full advantage of our unique talents and skills—the product of our free way of life. We must make fundamental changes no matter how deeply they cut through sentiment or tradition. I respect and admire tradition. I value the importance of "esprit de corps." But when these fine heritages interfere with human progress and threaten our very security, I feel that we must have the moral courage to relegate them to the nostalgic past and to make the necessary fundamental changes in our military setup. If we wait until such changes are forced upon us by the march of events, they may come too late. They must be made now as a product of foresight and logic. And it is to this end that our thought should be dedicated.

COMMANDERS AND THEIR STAFF AT ALL ECHELONS
AND IN EVERY BRANCH HAVE A VITAL STAKE
IN . . . .

training the pentomic soldier

by Major Max L. Marshall, USA
Chief, Services Films Office
Production Division, USA Pictorial Center

NEVER BEFORE IN HISTORY HAVE military forces, relentlessly spurred by a galloping technology, been required to undergo such rapid and drastic evolution in tactics, weapons, materiel, and organization for combat. In a race against the time-clock of pressing necessity, a revolution in military doctrine and techniques rumbles on, as "advanced" or "unconventional" weapons and materiel—and above all, *ideas*—first become "operational" and relatively soon thereafter, become generally accepted as "conventional."

All the while, the new weapons systems must continuously be integrated into the Army's new pentomic organizations, optimum employment patterns must be worked out, and the troops instructed in their use. Considering this along with the requirement to fill the enormous soldier-skill reservoir needed to support today's military technology, the whole clearly comprises a training problem of staggering proportions.

Equally important, if not so apparent a training requirement, is the necessity of leading the *thinking* of officers and men alike *away* from the old, familiar and previously successful methods used during World War II and the Korean Conflict, *toward* the not yet fully developed pentomic tactics that the future will demand. France, during the peace interval between the two World Wars, wasted precious training time perfecting the tactics of World War I. The thinking of her officers and men was geared to the past. This resulted in her swift defeat early in World War II by an enemy who had improved the infant weapons of World War I—armor and air power—and formulated new and dynamic tactics for their employment—the *blitzkrieg*.

The United States Pentomic Army and the tactics being designed to support it definitely are oriented toward the future. But the ultimate responsibility for the success of the enormous re-training program involved must rest directly on the shoulders of the commander and his staff, at all echelons.

The training methods available for use in this far-reaching effort necessitating the imparting and exchange of so much new, strange, complicated and detailed information are fairly well defined. These range from classroom presentations, through practical work in the field, to field maneuvers; from formal high level staff conferences to spontaneous informal discussions. Highly specialized presentations will be made to small groups of key planners, and large demonstrations will be held before masses of soldiers.

Training aids — mock-ups, transparencies, models, charts, and others—will be produced in quantity to support the various instructional means. Many of these the commander himself will have constructed; for some he will turn to his next higher headquarters. Others, reflecting the complexity of modern warfare, will be beyond the capability of even major units in the field to produce, and must be provided by staff echelons as high as Department of the Army.

Chief among these is the Army training film.

Training films are ideally suited to effectively, uniformly, and quickly instruct large numbers of officers and men concerning the operation and maintenance of the new weapons and equipment continuously being made available through the research and development program. Also, they are excellent for teaching officers and men the best available pentomic tactical doctrine on the integrated employment of the combined arms.

In the how-to-operate-and-maintain category, excellent film production work is being accomplished in connection with a vigorous over-all program to insure that the troops who will use the new weapons and materiel are thoroughly trained, and simultaneously, to see to it that the technicians charged with their upkeep are well qualified.

A case in point is the success being attained in the Nike training film program, designed to make available to the field training films concerning new items of equipment which go into both the Ajax and Hercules antiaircraft defense systems *as the equipment is delivered to the troops*. This training supplement tends to reduce inches from the thick and unwieldly technical and training texts which otherwise would have to be prepared and distributed, speeds up the training, and improves its quality.

Throughout, the technical services actively exploit the advantages of the training film in order to provide mass technical instruction to large numbers of soldiers. The success of such programs is attested by the relatively favorable training status of Army technicians considering the large turnover due to losses to industry and the perpetual re-training effort this necessitates.

Research and Development

Research and development is another vital area in which Army pictorial support is making extremely worthwhile contributions. Though much of what is currently being done is classified, these efforts contribute substantially to the constant study and improvement of materiel now on hand, and to the introduction of new and completely different items.

Ultimately however, the efforts of those involved in the Research and Development Program and of the members of the technical services are aimed at supplying the field commander with the best possible weapons systems and supporting materiel, and providing him with trained men who can operate them. The integrated use of trained men, weapons, systems, and materiel involves the formulation of optimum combat organizations and fighting techniques —as we know them today, *pentomic units* and *pentomic tactics*. Here is a key area where training films can make further substantial contributions.

Films can clearly show masses of troops how our new Pentomic Army is organized for combat and the various ways it can be fought. Superior to any other means short of the real thing, the training film can impart the psychological "feel" of the new and strange battlefield over which our soldiers may some day be called upon to fight, thus reducing any fear of the unknown and imparting confidence which comes of knowledge and familiarity.

No phase of advanced tactics is too difficult to depict clearly, forcefully, and, with respect to the training time involved, economically. Nor is any portion of the training problem too complicated to illustrate.

Saving Time

If the action takes place in different geographical areas over different periods of time—a tactical exercise on the attack, for example—the whole can be meaningfully presented in a film of less than an hour's duration by means of the physical movement of only a handful of cameramen and technicians, rather than the laborious and inefficient hurry-up-and-wait process of having groups of observers go from one vantage point to another to see, piecemeal, seemingly unrelated facets of the maneuver.

If the instruction is being conducted by orientation teams touring various headquarters throughout the country and carrying with them highly-specialized training aids to orient commanders and their staffs concerning specific vital subjects, how much more efficient, faster and cheaper to film just one such presentation, then immediately release it to the field? All the designated headquarters simultaneously would receive information while it was still up-to-the-minute—as opposed to the

possibility that a year might otherwise elapse between the first and the last presentations.

Some of the films now in existence and fully appropriate for use in training pentomic units pertain to such subjects as counterintelligence in combat, terrain analysis, and security measures in the field. In a sense, these are on the fringe of tactics since they do not specifically illustrate how to fight existing pentomic units.

On hand also, and left over from World War II and the Korean Conflict, are a large number of films on solid how-to-fight tactics. Based as they were on the old triangular unit organization—which utilized a weapons system now being replaced, their usefulness today in training the pentomic soldier becomes increasingly limited. In short, what is available in the field today cannot do the job satisfactorily.

Counterbalancing this somewhat is the fact that a number of how-to-fight training films appropriate to the Pentomic Army are now in production; more are in the process of being programmed. Still more encouraging is the fact that an increasing awareness is taking place of the necessity to replace the dated World War II inventory with new training films depicting pentomic tactics.

Because time is such a precious commodity to the Military, it is indicated that a stepped-up program should be pushed immediately. It must be recognized that training film production, like many other aspects of modern war preparation, must be accomplished in peacetime—that what is left to be done later, may very well never be done. A prohibitive amount of time is required to produce a large number and variety of films even under the pressure of wartime emergency, and there is the possibility of early bomb damage to production facilities. *Now* is the time to begin pressing a comprehensive training film program designed to completely replace that which is outmoded in the existing training film inventory.

The Attack of Tomorrow

One concept of the attack of tomorrow envisions the initial dispersal of highly mobile fighting units capable of quickly falling upon and defeating an enemy force in conjunction with the exploitation of an atomic shot. Another considers the use of helicopter-borne troops in the vertical envelopment with or without atomic support.

A splendid film, "The Pentomic Army," *TF-20-2561*, has recently been released which depicts in broad terms the organization, weapons, materiel and tactics to be generally employed by major units. Needed equally as badly are a number of films which will translate the generalities of the Big Picture to the specifics which must be implemented by subordinate units in order to do the job—such subjects as "The Battle Group in the Attack" (and in the Defense), "Pentomic Division Artillery," "The Pentomic Division Engineer Battalion," etc.

Entirely new techniques will be demanded of the various branches which support the infantry, armor and artillery in future combat operations. Signal communications, for example, must change in kind and expand in degree and flexibility to enable the commander to retain control of his units. Again, films depicting in broad, general terms new techniques being evolved by the Signal Corps to support modern tactics—such as electronic warfare, area communications, combat surveillance—are being prepared. Films designed to train specific signal units in the details of tactical employment might well be speeded along.

Whether or not atomic bombs are used in any future conflict, there is an absolute requirement that a number of officers be highly proficient in planning and executing an atomic shot, and that the rest of the officer corps be sufficiently familiar with the weapon to favor its maximum exploitation. Here again, appropriate training films could hasten and improve current instruction conducted in these areas and ease the work load on the commander, the Service School and the student.

Represented above are but a few of the tactical subjects which should be in the hands of the troops before long. There are others, perhaps in an even higher priority category, which should be done first. The important thing is that full advantage be taken of the Army's most precious peacetime possession—*time*—and that necessary programs be pressed forward as rapidly as possible.

To accomplish this, certain difficulties must be dealt with.

Among these is the fact that pentomic tactics by their very nature are fluid, subject to constant change and improvement, and as such, are a perishable product: training films which depict them will have to be brought up to date more frequently than previously.

A related obstacle, also caused by the evolutionary characteristic of modern tactics, is the cautious attitude sometimes taken to hold back on expensive motion picture production until doctrine becomes "firm." But, if one side of the coin of folly is the ill-considered and wasteful production of pictures which too soon will become obsolete, then the other side of the coin is an overly-cautious approach which prevents the distribution to the field of sorely needed training films to meet legitimate training requirements.

Procedures involved in initiating, coordinating and clearing such films will have to be streamlined so that the elapsed time before a given film is distributed to the troops is held down as closely as possible to the six months required for actual production. Perhaps an expediting system similar to that currently employed by CONARC to speed the distribution of training texts to pentomic field units will be the answer.

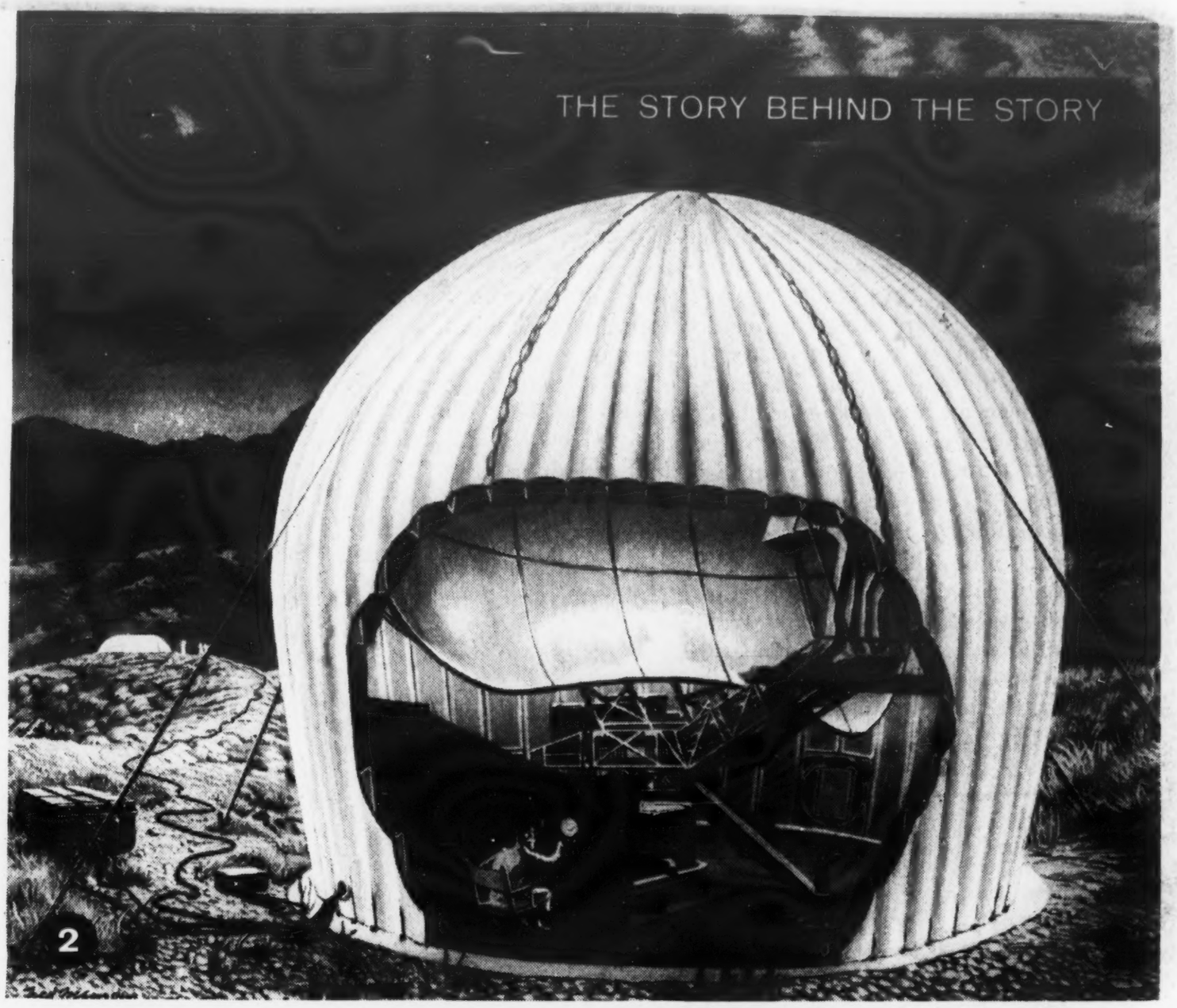
Another problem is to educate commanders and their staffs at every echelon and in every branch concerning the influence they can and should—indeed *must*—exert with regard to obtaining the kind of training films they need at a rate compatible with their increased training obligations.

In the final analysis, the sole reason for producing training films is to assist *the commander* in his mission of training his command, for which he alone is responsible.

The staffs of the respective top level agencies concerned with training film production are largely composed of officers who themselves have had experience in troop command and staff positions. They understand the over-all training problem and attempt to provide the best film program possible. But it is the commander *in the field today* who best understands the training problems he is faced with *now*, and it is necessary that he actively participate in procuring the kind of films and the number of films he needs to discharge his training responsibilities. When confronted with a situation in which a training requirement can best be met by means of a training film, a letter to the appropriate branch Service School, or to CONARC, is clearly indicated. By so doing, the commander will not only contribute to having films produced that best fit his requirements, but will also promote a program which will improve the active Army's over-all training capability and combat-readiness status.

The Reserve components of the Army, likewise, will benefit from the fruits of a vigorous training film pro-

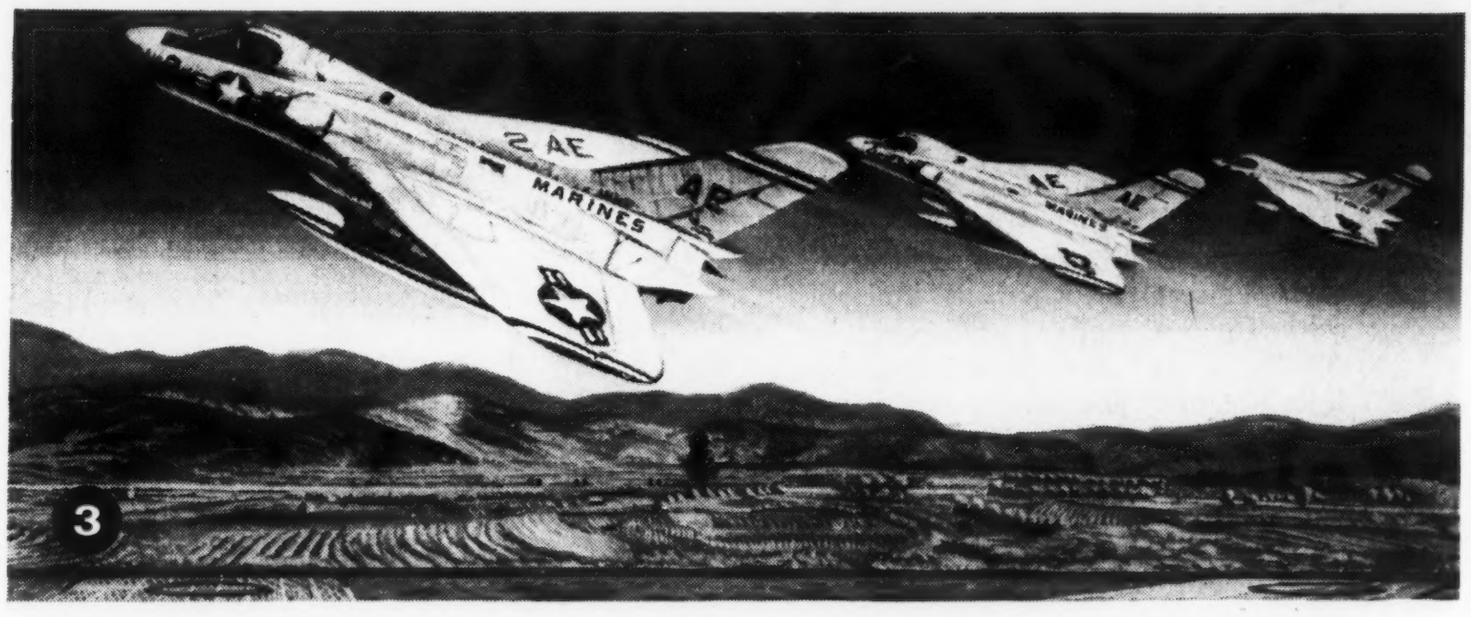
(*Continued on page 24*)



1 MARINE CORPS helicopters hover over TEW site, drop antenna, generators, radome and combat control shelter. Miniaturized components contribute to light weight.

2 WITHIN TWO HOURS TEW system is in operation. At approach of enemy aircraft, signals from antenna feed through monitored console to combat interceptor shelter nearby. Here range azimuth and altitude data are presented on plan-position indicators for command decision on interception.

3 ALERTED BY TEW, Marine jets scramble to intercept enemy. Extreme range of TEW provides extra minutes to throw up air umbrella over target area. Fighters carry air-to-air missiles like Sparrow I developed by Sperry.



NEW PORTABLE RADAR TO GUARD MARINE OUTPOSTS

Can be flown to site, set up in 2 hours

As fast on the move as a fighting Marine is the new "TEW" (tactical early warning) radar system being developed by Sperry for the Marine Corps. Only one-fourth the size and weight of conventional radars, TEW is easily carried to battle areas by helicopter, cargo plane, truck or amphibious vehicle. Within two hours, an 18-man crew can erect the TEW system and place it in operation.

Designed to detect both close-in and distant supersonic aircraft and missiles, TEW also determines their height—combining the functions of two present radar systems. Its operation is almost completely automatic, requiring only one operator to monitor its control console. Radar console and rotating antenna are housed in an inflatable radome, while the combat interceptor control shelter which completes the TEW system is located nearby. Both can withstand the rigors of arctic or tropical climates.

With its very long range and portable construction, TEW provides the Marines with the means to extend the nation's defense perimeter and insure added protection for key installations and outposts. Like the new super-radars developed by Sperry for the Navy's missile cruisers, TEW is an important contribution to our growing power to deter aggression.

SURFACE ARMAMENT DIVISION

SPERRY GYROSCOPE COMPANY
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

Pentomic Soldier (*Continued from page* 22)

gram. The Reserve Unit Commander, often faced with inadequate training facilities, always limited with respect to training time available, in many instances must depend heavily upon the film as the best—sometimes only—means of getting across his instruction effectively. Since support of the Reserve program becomes increasingly important as the Active Army becomes smaller, everything possible must be done to assist these units to achieve an acceptable level of combat readiness; this in itself provides heavy justification for producing up-to-date training films on a large variety of subjects.

A side benefit provided by the existence of an adequate inventory of training films has to do with the Allies who will fight with the United States in the event of future aggression. The term "foreign adaptation" is applied to a process wherein Army training films are re-narrated into the language of friendly nations. Because many of these countries will be using U. S. weapons, and in varying degrees, adopting U. S. tactics in any future conflict. foreign adaptations—which completely surmount language barriers—will, as in the Korean Conflict, prove to be invaluable.

But however important such side benefits may be, the immediate requirement to step up the over-all film production program is based on the following Big-Picture realities:

To prevent war, the United States must have an atomic and guided missile capability sufficient to counter and offset the large troop masses our potential enemies can muster. The Army is committed to a readiness posture which calls for it to be able to fight in a "brush-fire" conflict, an atomic war, or any kind of action in between.

The degree of success obtained toward meeting this objective will depend upon the effectiveness of the Army's training program; this in turn is related to a number of factors—among them the effectiveness of the training aids made available to the commander to help him perform his training mission.

Training films are ideally suited to teaching large numbers of officers and men tomorrow's tactics today, generating discussion and thought which will lead to improvements in new doctrine, and to defining the new directions toward which future warfare is moving.

MATS (*Continued from page* 10)

was done in three weeks time under conditions of extremely inclement weather. After Safe Haven I, Safe Haven II was conducted over a period of five months on a very reduced basis (approximately three trips a week). This entire operation was completed in May last year with MATS carrying about 15,000 Hungarian refugees to this country.

AACS is our largest technical service and a mission most people are familiar with. They are deployed all over the world, operating complicated equipment which is indispensable for our modern air operations. AACS is our communications lifeline, not only for MATS but for all commands of the Air Force.

The Air Weather Service, aside from the normal service, performs a number of operations that are essential to our strike forces. For example, they operate several weather reconnaissance squadrons, deployed world-wide, each flying one or two trips each day into very remote areas in order to gather weather data. Once a day from Alaska they fly over the North Pole and back; one or two times a day they fly the remote areas from the Aleutian Chain to Japan.

The Air Rescue Service is probably the most glamorous one in MATS. Their motto, "That Others May Live," is most appropriate. During the Korean War they rescued over 1,000 personnel from behind the enemy lines. Surely you have read of the many rescues performed by ARS in normal day-by-day civilian and military flying. Perhaps you recall the stratocruiser that went down in Puget Sound a year or so ago. Within 15 minutes an amphibious SA-16 was at the scene of the disaster and within 33 minutes all survivors (I believe there were over 30) were safe and sound ashore.

The Air Photographic and Charting Service is probably the least known of our technical services. They provide the maps used in our air operations through their cartographic facilities here in St. Louis. They conduct quite an extensive aerial photographic program in many places throughout the world. They employ a technique known as "trilateration," a combination of both electronic and celestial techniques to determine, very accurately, positions on the earth's surface. Work along these lines is very important in the guided missile program. One of their missions involved a three-month operation in three camps on the Greenland Ice Cap.

We also operate the Air Base in Keflavik, Iceland, including the radar sites and the fighter aircraft stationed there for the air defense of that island.

So you see, MATS is a very diversified command performing a number of services, most of which make up the essential elements of an air transport system. Airlift does not grow up overnight and if it is to be immediately responsive in time of emergency, airlift must be exercised continuously. This then is MATS.

Before I conclude, I would like to mention our air crews. With all due respect to the many thousands of people in MATS who perform the many technical services on the ground, the power and the glory of MATS lies in its air crews. Over 650,000 passengers a year entrust their lives to our crews. This is indeed a tremendous responsibility and we devote a great deal of time and effort to make certain that these crews are equal to that responsibility. Most of our pilots are Lieutenants and Captains—some are Majors—and their average pay is probably something around $450 per month, whereas the overocean captain of a commercial airline is making anywhere from $1,200 to $1,600 per month. The aircraft commander of MATS is a highly trained pilot who has demonstrated without any doubt that he is thoroughly familiar with his aircraft and all the systems that operate within it. Frequently throughout the year he is examined and tested on emergency procedures. No pilot in MATS can retain his aircraft commander status if at any time he has exercised poor judgment or demonstrated a lack of proficiency. The standard of our crews is attested by the recent emergency in the Pacific where one of our C-97s, after losing two engines, flew over a thousand miles at wave-top level with 58 passengers aboard. Major Tyson, the aircraft commander of this airplane (who had accumulated a total of 6,000 hours), was able to get his airplane to safety not only because he knew his airplane thoroughly and its operational characteristics. The courage, determination, and fortitude of aircraft commanders of this type cannot be bought. Fifty-eight passengers aboard this aircraft will never forget Major Tyson.

The above was an address delivered by General Wilson to the Scott-St. Louis Chapter of the Armed Forces Communications and Electronics Association.

by

Dr. C. C. Furnas, Chancellor

University of Buffalo

SCIENCE and INDUSTRY in the next decade

MAKING PREDICTIONS ABOUT the next hundred years is a fairly safe occupation. One does not expect to be around long enough to have colleagues tell him how wrong his predictions were. But, since hope springs eternal, we all hope to be around for at least another ten years; so, when we make forecasts for the next decade, in keeping with the title, we have to watch our step. However, if you are willing to adopt a charitable attitude, I am willing to explore the clouded crystal ball with you.

Any predictions which are made must necessarily involve some assumptions about the future international situation. It is impossible for this or any other country to live unto itself alone.

If there should be a major military conflict, any forecasts of almost any kind would certainly become invalid. Anyone who has any knowledge at all of the destructive capabilities of modern weapons visualizes the horrible destruction which would ensue and fervently hopes that World War III will not occur. Divorcing myself as far as possible from wishful thinking, I do have great faith that there will be no World War III. This faith is based on my firm belief that America, now that it is beginning to face the issue squarely (at least partially due to the October 4, 1957 appearance of the first Sputnik overhead) will maintain military strength adequate to discourage any wholesale aggression. General Schriever's article has given real substance to that faith. (See story in December 1957 issue of SIGNAL.)

The ideological and cold war conflict with the Communist block will undoubtedly continue. There may very well be more fringe military engagements. But, in my opinion, these conflicts will only be minor sociological earthquakes which seem almost inevitable in a world that is adjusting itself to a new way of life. They will not be major catastrophes. Because it involves the actions of a great many people, as producers and customers, industry is necessarily highly responsive to sociological phenomena. Two sociological factors in the world today will have a particular impact on industrial developments.

For various reasons, including the rapidly improving state of human health, we are in an era of explosive population growth.

Although the average American is well loaded with gadgets and services, he still feels that he needs many more physical assets in order to fulfill his own picture of the good life. But this desire to improve our lot is as nothing compared to the great surge of ambition among hundreds of millions throughout the rest of the world who have been eking out a life with only the barest means of subsistance.

Because of this greatly increased population and the feeling of hope on the part of the average citizen of the world—which leads to greatly increased per capita demand—there is an unprecedented, rising tide of demand for industrial goods and services, which will not be denied. Hence, I predict that for the next decade, and for long thereafter, industry—aided by science—will continue along the path of very rapid expansion throughout the world, as well as in the United States. As a corollary of this, America will inevitably be drawn increasingly into the international industrial scene.

Due to the inherent complexities of

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Furnas (*Continued*)

adaptation there is always a lag of at least a few years between new scientific discoveries and their industrial application, or military application for that matter. This is one reason why it is so important for us, as a Nation, to maintain a really effective program of background research. The new industrial developments of the next decade will necessarily be based primarily on the basic scientific knowledge which we now have in hand. I will first discuss some of the developments which will probably result from tapping the present reservoir of research knowledge.

Although it is now the subject of some modest political battles and discouraging economic dissertations, I predict that nuclear power production will be of substantial importance within ten years. At the present time, even the best nuclear power production costs at least 50% more than the power that can now be generated with coal or oil-fired steam plants. However, as the state of the nuclear art progresses, this gap will be closed and the cost figures will begin to go the other way. In other parts of the world, for instance in England, where fossil fuel costs are much greater than here, nuclear power is already economically feasible.

I am not basing this prediction on present production costs alone. As the industrial demand increases, it is inevitable that power requirements will increase very sharply. The actual, bona fide needs for power production will increase severalfold throughout the world during the next decade. The problem will be one of supplying the physical means of meeting the needs that are already here rather than trying to develop a demand. The time is now ripe to begin tapping and using the next great source of the world's energy supply, the nucleus of the atom.

As nuclear energy becomes increasingly important, the use of fossil fuels —coal, oil and gas—will necessarily decrease in relative importance. I also predict that, as this new trend becomes apparent, the petroleum industry will rise to new heights. Petroleum and coal (our fossil storehouses) will eventually become too valuable to use for fuel. They will be uniquely important for industrial use as the source of a host of valuable chemical raw materials. The petro-chemicals, which already stand out strongly in the industrial scene, will eventually become dominant in the organic field. You will see this trend developing during the next decade.

Chemical industry sales will top $25 billion in 1957. The index of production of industrial chemicals has increased by over 100 percent during the past ten years. This is very substantial growth in itself, but that segment of chemical production labelled "plastic materials" has increased by over 175 percent. Petroleum is the basic source of many of this kind of material. One may safely predict that these trends will continue. It is also safe to

say that research institutes can, and probably will, make substantial research and development contributions to products and processes of great value in the petro-chemical field.

Since we are dwelling on energy, it is appropriate to consider that ever-present and inexhaustible source—the sun. This is of particular interest in the South and Southwest. However, I have never been able to bring myself to join the ranks of the ultra-enthusiastic sun worshipers, at least as far as industrial application is concerned. Solar energy has some serious shortcomings. First, the supply is intermittent—even in Texas. Second, we receive it at a very low potential. When the sun is shining, the amount of energy coming to us is only about 1/10 of a horsepower per square foot. For practical industrial uses energy concentrations should be at least several hundred times as great as this. Hence it is unrealistic to assume that the sun can be our energy panacea.

In those parts of the world which have an abundance of sunshine but a low level of industrial technology, sunlight may be useful for an interim period in the form of simple solar engines for pumping water, solar stoves for cooking of food, and the like. In countries which have an advanced state of technology, such as the United States, the sun as a direct source of energy appears to be inadequate for these purposes.

For the United States, as well as for some other parts of the world, two other examples of practical application seem possible. In the southern half of this country, sunshine may be useful for the heating of houses. Even under the best conditions, however, it does not by itself meet the standards of comfort which we now demand. Experimental solar houses, however, have been designed and used which can take care of some 75% or more of the heating load in mild to temperate climates. It is my belief that this application of solar energy will expand, particularly in the sunny south, but it will not have any major impact on national energy demands.

Various experiments have been conducted with a certain amount of success on the use of sunshine for the evaporation of sea water to obtain fresh water. Research-wise, these experiments have been successful but economically they still have a long way to go. Fresh water, to be usable in large quantities, must be produced at very low cost. Since solar energy comes at a very low potential, it is necessary to have very large areas of apparatus exposed to the sun. These areas must be covered with glass or transparent plastic to capture the energy for carrying out the evaporation, and to contain the water vapor while it is condensed and drawn off. Whether the economics of the problem can be worked out satisfactorily is still an open question. In certain locations where fresh water is badly needed and close to the seashore, I would give this development a fair chance of economic success—but it is by no means a certainty.

Our future industry will not only call for increased energy supplies—ever-rising demands will be placed on our mineral resources. Although we have been in an era of major industrial development for only about two generations, our high-grade mineral resources are already being rapidly depleted. Not only in this country, but throughout the world, we must develop a technology which will make it possible to recover more and more mineral values from lower and lower-grade materials. This will not be simple, nor will it be easy. We must develop new ways of handling large quantities of low-grade ores and then selectively and economically extract the minerals which we need. Of course, various processes for the beneficiation of ores, such as copper, lead, zinc and silver have been used for many years. But we are going to have to make some great steps forward if we are to continue to satisfy the appetite of industry.

All this will require clever technology and the application of a great deal of inanimate energy. This again points up the necessity of planning for adequate power sources for the future.

Allow me to give one example of the possibilities of a new technology which could extract valuable materials from a low-grade source. On the average, ordinary granite, which makes up a large part of the crust of the earth, contains four parts per million of uranium and forty parts per million of thorium. If those two elements could be extracted from one ton of granite and used in a nuclear reactor, they would produce as much energy as the burning of fifty tons of coal. Hence, if we could develop a technology which could selectively recover the small traces of these two elements in a practical fashion, we could be assured of a supply of raw materials for our energy for all time to come. One can pick out similar examples for other materials.

The crust of the earth contains over eight per cent of aluminium—it is 50% more plentiful than iron. Despite this, presently usable aluminum ores are found in relatively few parts of the world. This is because we have not yet developed a low-cost, practical technology for winning aluminum from ordinary clay or rock. Several processes have been developed which are technically successful for materials other than the commonly used bauxite, but I know of none that can yet make the grade economically. When we do learn to obtain our aluminum from the soil beneath our feet, we will never need to worry any more about the supply of this valuable metal.

Copper is one of our most essential metals. America supplies about two-thirds of its needs and imports about one-third. The really high-grade ores in this country are largely gone; we are digging into the low-grade supplies. With the present technology, the raw ore must contain at least 0.8 per cent copper to be usable. If we could reduce the acceptable concentration by one-half-down to 0.4 per cent, the recoverable copper would probably be increased by some 10-fold. Such a development would be very useful—even within the next decade.

These three examples—uranium and thorium, aluminum, copper—are given to indicate that great new supplies of many valuable materials can be tapped when we develop appropriate technology. In each of these cases, it is my conviction the necessary technical advances will eventually be forthcoming. There will be newer and less expensive methods of digging and handling earthy and rocky materials and of grinding them into fine particles. There will be new tricks in *selective* chemical reactions, such as nature sometimes displays.

By 1967, substantial advances will be made in the profitable extraction of mineral values from the lower-grade materials. I do not anticipate that ordinary granite will be our uranium mines by that time, but we will have begun to point in that direction.

When one considers the mineral resources, he should not confine himself to the rocks and the soil. Perhaps the greatest mine of all can be found in the ocean. Already we are using the ocean as a source of raw material in a minor way. Bromine (which is used in the production of the Ethyl fluid for your high-test gasolines) and metallic magnesium have been extracted profitably from sea water for a number of years, but this by no means represents the limit of the possibilities. Actually, the ocean water contains a little bit of almost everything in the crust of the earth. Each year about 2% of the waters of the ocean are evaporated and then returned as rain. As the rain falls on the land, it picks up a little bit, either in solution or in suspension, of all of the crustal materials. So the ocean is a repository of nearly all the minerals which we find useful, albeit many of them are in extremely low concentrations.

One might assume that any thought of recovering other minerals from the sea is a bit of foolishness were it not for the performance of some very low-grade specimens of animal life. All gourmets know that oysters are not only delightful fare, but they are nutritionally good because they contain copper. Since oysters have never lived anywhere except in the sea, they naturally have got their copper from sea water. As a matter of fact, they are quite adept at this business. They concentrate copper within their gelatinous structures to the extent of several thousandfold over that in the ambient sea water. The slimy sea cucumber does even better. It concentrates vanadium by some 100,000-fold. It is obvious, however, that if it ever becomes important for us to begin ex-

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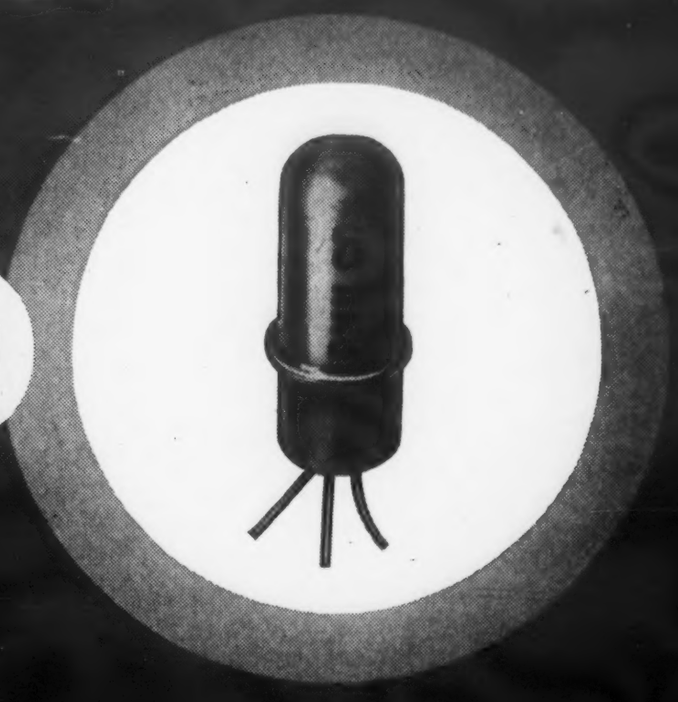

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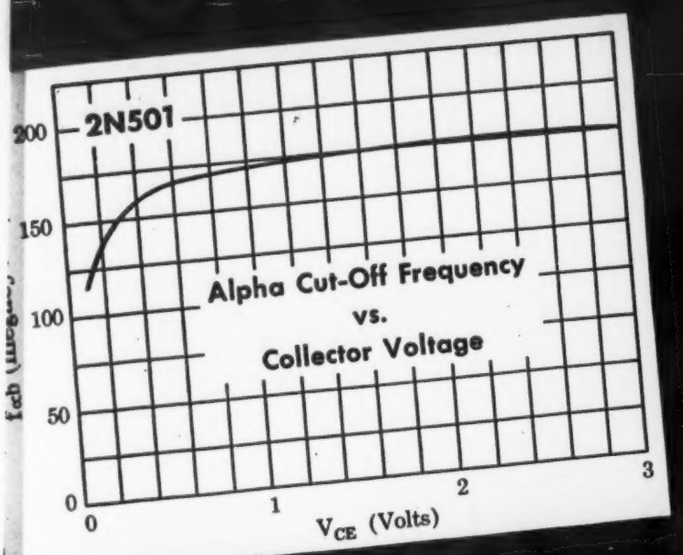

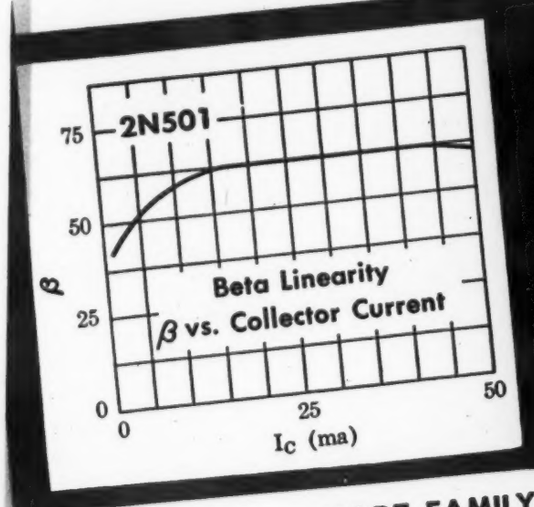

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2N500			25% at 200 mcs (min)	oscillator to 400 mcs
2N501	Ultra high-speed switch typical t_r = 12 mμsec; (18 max.); t_s = 7 mμsec; (12 max.); t_f = 4 mμsec; (10 max.). In circuit with current gain of 10 and voltage turnoff.			
2N502†	500 mcs	10 db at 200 mcs		amplifier to 250 mcs
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tracting a number of mineral substances from the sea, the laws of nature will permit us to do it.

When one views the opening possibilities of harnessing nuclear energy and sees the inevitable trend towards the depletion of our mineral resources and realizes that fresh water is going to be one of the most needed materials in many parts of the world, a new kind of industrial operation on the shores of the sea becomes understandable. Imagine, if you will, a large nuclear power plant close to the ocean shore which will be producing a great deal of electrical power at low cost. It will also be producing a great deal of energy in the form of gamma and neutron radiation and as sensible heat. As a corollary operation, this power plant will be imbibing large amounts of sea water. By reasonably well understood processes of electrical dialysis, base exchange, electrolysis and evaporation, several valuable minerals—such as bromine, magnesium, copper, vanadium, zinc, and perhaps gold and silver, will be profitably extracted from the sea water. A most valuable by-product in large quantity will be fresh water. Perhaps someone will dub this setup "Molly on the Shore" after the well-known Irish folk song.

The successful operation of such a plant will call for a combination of talents and processes which have not yet been put together. We are not far, however, from the possibility of realization. You will be hearing more of this sort of thing within the next decade.

Not only will there be exciting industrial developments during the next ten years; substantial basic research will also be going forward. It is even more foolish to predict the course of research than the probable development of the industrial pattern. However, one's curiosity is intrigued with certain research activities that are now beginning and we can well speculate on what may be forthcoming. I will mention three.

Plant life has been flourishing on the earth with varying stages of luxuriance for literally billions of years. This all comes about through the process of photosynthesis. The energy of the sun is captured and, by certain endothermic reactions, transforms carbon dioxide and water, and a few other chemicals, into the compounds of plants and hence eventually of animals. It is not a very efficient process. Even under the very best of conditions the score is not more than 2% in terms of the energy balance. But it is a persistent one and is basic to all living matter, including ourselves. We do not yet understand fully how nature does it, but through the use of radioactive tracers we have come much closer to understanding the chemical and biological kinetics during the past few years than ever before. I anticipate that during the next decade we shall have a practically complete understanding of natural photosynthesis. That is, we will know what makes the grass green.

Understanding this basic natural process will be very important. When we do have those fundamental answers, industry will become interested. We will not attempt merely to duplicate nature. We will, as has often occurred in the past, point up a program for improving on her processes. There will be attempts, and eventually they will be successful, toward using sunshine as a source of energy to produce, by artificial photosynthesis, various carbohydrates and hydrocarbons which may well serve as our perpetual supply of liquid fuel. No matter how much energy we may have available, we will always need liquid fuel and this may be the best way to get it. Further, if we can really master photosynthetic processes, we may very well use them for the production of simple foodstuffs which can at least be useful for animal if not human consumption. Further speculation at this point would probably be quite pointless because we do not yet have enough knowledge to give it any ring of possible reality.

The chemists and the physicists, however, will not be satisfied with exploring the possibilities of the use of solar radiation alone. The known spectrum of electromagnetic radiation encompasses some 58 octaves. The visible spectrum, that is, sunlight, covers only about one octave. When nuclear reactors become a major source of power, a tremendous amount of radiation in the form of gamma rays and neutrons, the high energy levels, will be available. This opens up the possibility of a great many radiation-induced chemical reactions that have not yet been explored. There has been some preliminary experimentation, but very little of real substance. What new chemical syntheses are possible or what desirable modification of known compounds may be attained, we do not know. I think many research men will be looking into the possibilities, particularly as large supplies of high energy radiation nuclear power plant become available at low cost.

Peaceful Use of H-Bomb

Ever since the first hydrogen bomb was set off a few years ago, the physicists have been intrigued with the possibilities of using the fusion reaction, under controlled conditions, as a source of energy for peaceful purposes. The reaction of the hydrogen bomb is essentially the same as that which occurs in the sun and, hence, is getting very close to the true fundamentals of the cosmic energy supply. Experimentation with the goal of achieving a controlled fusion (hydrogen bomb) reaction is going forward rapidly in several countries. The researchers involved will make no predictions of the success, but some of them do seem to have a hopeful gleam in their eyes. Do not be at all surprised if, within the next decade, they announce that they have enough fundamental knowledge to begin the development of practical power plants for a controlled supply of energy from the fusion reaction.

If that research success is attained, it will be a true landmark in industrial development. The basic raw material will be heavy hydrogen (deuterium) which occurs in quite appreciable amounts in all water, including the sea. The supply of the raw material is essentially infinite and the amount of energy which could be obtained from the process is almost beyond belief. By its very nature the process is one which would probably have to operate in very large units. However, if it is successful at all, it will probably lead to the production of electrical energy in greater quantities than we have ever imagined and at extremely low costs. One does not need to be a dreamer to visualize the new horizons from such a development.

You may or may not have any faith in either my industrial development or research predictions. You may feel that I should have dwelled on other samples than the ones chosen. However, you must concede that the world of science and technology will continue to advance and that there will be many changes, probably quite rapid ones. We all realize now that, as never before, the world refuses to stand still and that those who lead the procession and benefit most are those who explore the unknown most assiduously.

The path of progress is quite clear. It goes from education, to research, to industry. Are our research and educational programs adequate to keep ahead in the international competition which, we must admit, is very severe in both the civilian and military fields? I cannot give a clean-cut answer to that question, but I can point up the progress and some of the problems.

The change in quantity and scope of American research and development before and after World War II has been quite dramatic. In 1940 the estimated total national expenditure on research and development (military and civilan) was $345 million. In 1956 the estimated total was $5 billion—an increase of 1450%. Governmental expenditures on research and development (largely military) were about $67 million in 1940, and about $2.5 billion in 1956—an increase of 3600%. The 1956 expenditures were over 1 per cent of the Gross National Product.

The largest single segment of support of R and D comes from the Department of Defense. The military expenditures for R and D this fiscal year will be something over one billion six hundred million dollars—about one-third of the total national expenditure in this area. About one-half these R and D dollars go to industrial contracts, about ten per cent to universities and other non-profit research establishments, and about forty per cent to government establishments. About forty per cent of all the scientists and engineers of the country, who are engaged in R and D, are working on some phase of the military program.

These numbers represent a true revolution in the approach to and implementation of military programs during the past generation.

Other governmental agencies, beside the Department of Defense, make substantial expenditures for R and D. The Atomic Energy Commission, the National Advisory Committee for Aeronautics, the National Science Foundation, the National Bureau of Standards, and the National Institute of Health are among the more important and outstanding. Lumped together the nonmiltary governmental departments' expenditures now approximate a billion dollars per year. Hence the federal government is footing the bill for approximately 50% (perhaps somewhat more) of the R and D effort of the Nation. The rest of the financial support is provided by industry, state and local governments, endowed foundations and (in decreasing proportion) by universities.

This is only part of the story. Even when a device, system, material or process has gone through research and development, it is usually not yet ready for practical use. There still remains the activity which I choose to call "adaptation." In the military field this adaptation takes the form of engineering and building substantial numbers of prototypes (e. g., of missiles or manned aircraft), thoroughly testing them, redesigning and retesting for improvements, developing tactics for use, etc. The bill for this adaptation of military weapons and weapons systems is about twice the R and D bill. In FY 1958 the Department of Defense will spend over three and one-half billion dollars on the adaptation phase; the money coming from procurement funds rather than from the R and D part of the budget.

There is an analogous "adaptation" phase in industry, which follows an R and D program. This takes the form of building test quantities for prospective customer acceptance, market surveys, designing and building first production plants, preparing servicing systems, etc. As in the case of the Military, these expenditures can well mount up to at least twice the R and D expenditures.

Thus if we are spending one per cent of the Gross National Product on R and D, and the adaptation phase costs twice as much, the total cost of implementing new ideas for military and for peaceful pursuits in this country is now running some three per cent of the Gross National Product. Is this too much? I may be accused of prejudice but I am firmly of the opinion that it is not too much—that it is probably lower than it should be. Three per cent is a very small proportion to be paying for steadily improving the character and quantity of goods and services for public use and for improving military defense. Viewed from the strictly financial point of view, these developments in industry, on the average, much more than pay for themselves in a relatively few years.

Particularly since the arrival of Sputnik, it has become popular to make loud and impassioned declarations that what this country needs is more "basic" research. I'm not certain that all the orators understand what basic research is, but I'm willing to go along with their conclusions. We *do* need more such research because our reservoirs of new knowledge of the laws of nature are running low. Moreover, the competition may be outdoing us at the present time.

With a few notable exceptions, industrial research laboratories do not indulge in very much basic research —in the true sense of the word. Almost everyone is so involved in being practical that it's very difficult to get substantial support for this type of research. There is ample evidence that nearly all new fundamental knowledge is applied to something sooner or later, and hence ends up being practical. Nevertheless, sponsors, governmental or private, usually are overly cautious about putting very much money on the long shots. They prefer to play the safer ponies. I believe our national program suffers from this timidity.

R & D Financial Support

As was pointed out, about half of the financial support of the national R and D program comes from the Federal Government. The bulk of the rest of it comes from industry itself, with endowed foundations, universities and individuals giving significant, even though small, assistance in backing up the line. Most of the eggs of support are in the two large baskets. This is a natural pattern in our present-day society but it has some disadvantages. There is a strong tendency for those agencies which support the program to do the work themselves. This leads to a monolithic (in this case, actually a duolithic) structure. Thus, there is a trend toward squeezing out some of the most important sources of basic research results. Although universities and the many estimable not-for-profit research institutions do get substantial dollar support from both government and industry. I contend they do not get a large enough proportion. These universities and these institutes are the most fertile sources of new research men and new research ideas; the national body cannot remain healthy for long if these essential elements remain malnourished. I am suggesting strongly that everyone will benefit substantially if both government and industry curb the trend toward ever larger and more self-contained laboratories of their own and throw increased support to competent universities and research institutes. A fluid, dynamic pattern of free enterprise is even more essential for research than it is for industrial production.

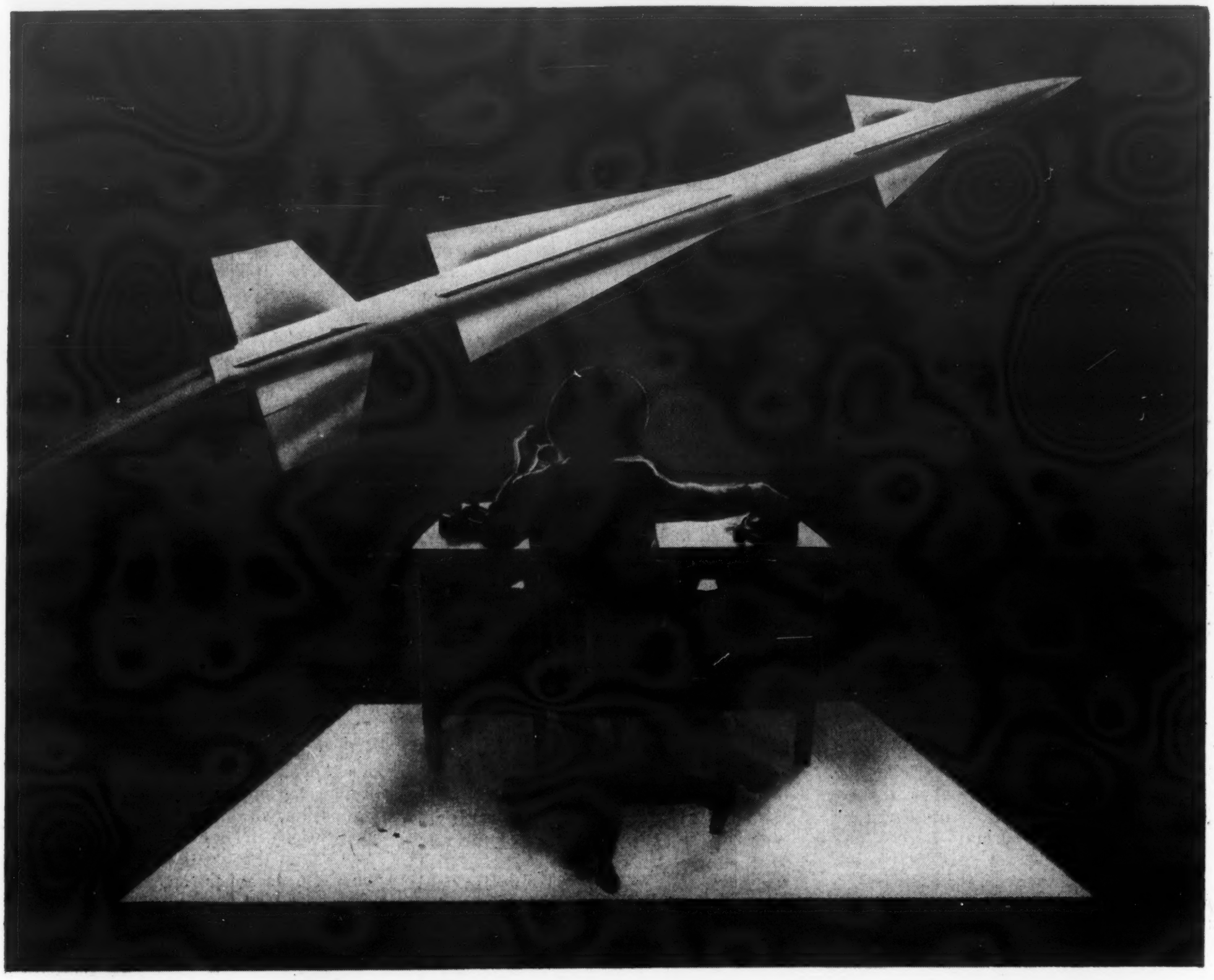
As a final thought on this subject of support I will air my favorite gripe—inadequate overhead on research contracts or grants. Although industry usually allows universities and others to charge adequate overhead to cover full costs on research projects, the Federal Government does not. Even under the so-called "Blue Book" formula which is used by some government agencies, universities never recover their full and legitimate overhead costs. For this university type of contract some government agencies allow even less overhead and some important ones allow none at all. If this pattern is not corrected soon, some of the important research segments of universities and institutes will go bankrupt, simply because they are so prosperous with research contracts. This would be an absurd situation and certainly not in the national interest. The golden-egged goose can't withstand malnutrition forever.

A billion dollars worth of research equipment isn't worth a nickel for its intended purpose unless it is operated by competent men and women—scientists and engineers. These scientists and engineers come from our colleges and universities—in this complicated world there is no other source. Ironically, in this period of greatest peacetime prosperity we have ever known, our colleges and universities are in a sad financial state. Last year Americans spent less than 0.8 per cent of the Gross National Product on all higher education, in both public and private institutions. They spent 50 per cent more than that on tobacco and two and one-half as much on alcoholic beverages.

During the next decade the situation will become worse, because of the press of numbers, if nothing else. Due to the very high post-war birth rate, there will be twice as many young American men and women of college age fifteen years from now as there are in 1957. There are not now and apparently will not be adequate buildings, laboratories and, particularly, competent faculty personnel to meet the needs.

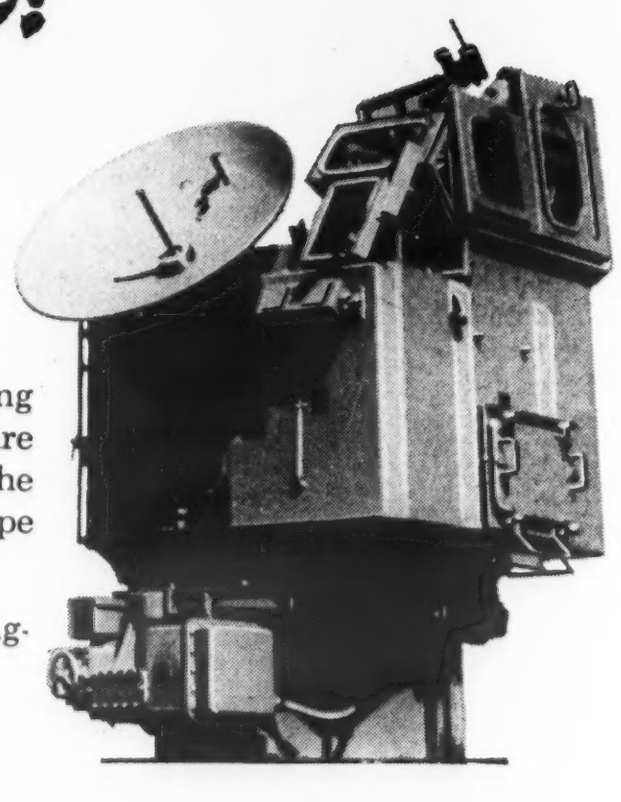
I shall go no further in to this matter. My reason for bringing it up is that the prosperity of modern industry depends upon the health of the research program, and a research program can only progress if the colleges and universities produce an adequate number of really competent scientists and engineers.

I trust I am being only realistic, not unduly gloomy. Actually I am a longtime optimist, as I trust my predictions about industry have indicated. But those predictions can only become realities if we as a Nation provide adequate educational and research substance, and if we face the future situation with determination and hard work and avoid panicky or hasty action. Provided World War III can be avoided we have in our hands the possibility of a new industrial revolution which can lead eventually to true world-wide peace and prosperity.



Space Reporter at Work!

. . . must be accurate . . . must be reliable



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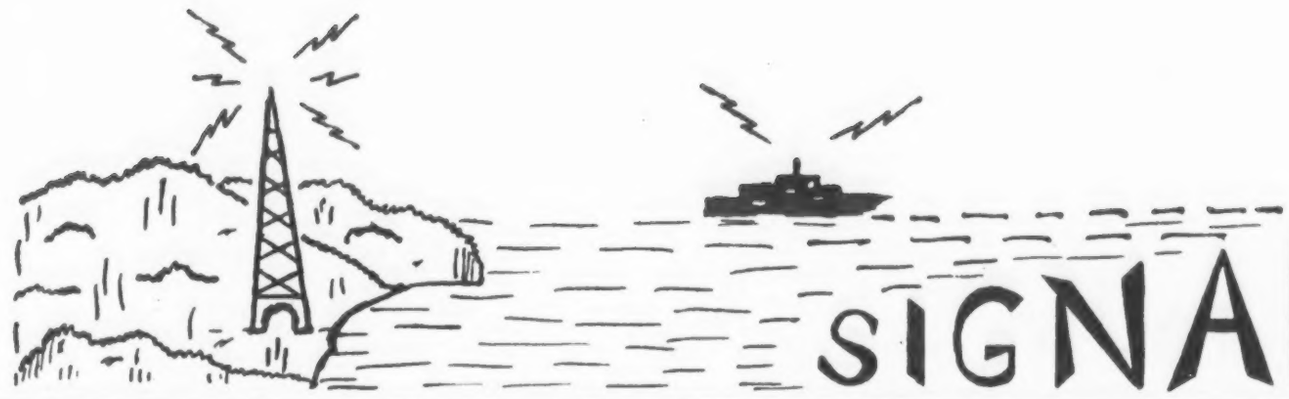


SIGNAL·GRAM

— GOVERNMENT —

FULLY AUTOMATIC COMMUNICATION RELAY CENTER The U. S. Air Force inaugurated the first in a series of fully automatic communication relay centers at Andrews AFB STRATCOM Center in March. Previously, the thousands of daily teletype messages were processed manually. This is now accomplished automatically by a switching director/translator combination which interprets the routing indicators perforated in the teletype tapes and electronically selects the proper transmission channels cross-office. Known as Plan 55, the automatic equipment was designed by the Western Union Telegraph Co. and incorporates the existing semi-automatic systems.

DRONE GUIDANCE SYSTEM TO TEST AIR DEFENSES An electronic system designed to help the Air Force test U. S. defenses against the most modern air weapons available to an enemy has been demonstrated successfully by the USAF and Sperry Gyroscope Company. This microwave command guidance system is being considered as a "universal" system for remotely controlling other target drones, pilotless aircraft and missiles over great distances. The control station, located inside a specially-equipped air transportable van, houses radar and control equipment, communications and recording equipment, and personnel.

METALLIC CONFETTI USED TO MEASURE WINDS Army Signal Corps Scientists have developed a method for measuring winds in the upper atmosphere. Using small Loki II rockets, the Army is shooting packets of confetti-like aluminum chaff more than 50 miles into space, then tracking them by radar to give, swiftly and accurately, an unbroken map of wind and direction. Such maps, say scientists, will now be available for the first time in history.

EXPENDITURES MENTIONED AT THE MILITARY-INDUSTRIAL CONFERENCE IN CHICAGO Between '50-'57, Washington supplied around $20 billion to allies in the joint military effort. The allies themselves spent $110 billion in that period. It would have cost us much more to try to support an equal military establishment by ourselves simply because it costs much more to pay, house and feed a U. S. serviceman ($3515) than a French soldier ($1440), or a Pakistani ($485), a Greek ($424) or a Formosan Chinese ($147).

CONTRACTS: ARMY: Raytheon Manufacturing Company, engineering services on the HAWK missile program, $8,490,866; Burroughs Corporation, electronic communications equipment, $3,900,000; Radio Corporation of America, follow up a major breakthrough in electronic miniaturization, $5,000,000; The Martin Company, production of the LACROSSE surface-to-surface guided missile, $16,000,000. NAVY: Convair, Division of General Dynamics Corporation, pilot line production of TARTAR guided missiles, $8,000,000; Philco Corporation, continued production of the SIDEWINDER, $15,000,000; General Electric Company, continued production of the SIDEWINDER, $10,000,000; Sperry Gyroscope Company, Division of Sperry Rand Corp., production of major components of TALOS and TERRIER, $63,000,000; Sylvania Electric Products, Inc., manufacture of subminiature electron tubes, $1.035,000; AIR FORCE: Fairchild Camera and Instrument Corporation, camera bodies, $1,569,000; Hughes Aircraft Company, technical services, $1,568,000; Servo Corporation of America, development of infrared reconnaissance system, $583,820; American Bosch Arma Corporation, research and development contract for inertial guidance systems for TITAN, $140,357,000.

— INDUSTRY —

AIRPORT COMMUNICATION MODERNIZATION A television system to enable passengers and airline personnel to watch flight schedules from fourteen strategic points in an air terminal has been installed for Trans World Airlines, Inc., by the Radio Corporation of America at the Municipal Airport in Kansas City, Missouri. The fourteen RCA Victor receivers are linked by closed-circuit to TWA's airport operations office, where a camera is focused on a master flight board listing up-to-the minute data on as many as twelve current flights. (Continued on page 37)

A 1957 AFCEA Convention Presentation

A Simple Technique For Handling Complex Microwave Circuits

by Alexander Horvath, Electronic Defense Laboratory, Sylvania Electric Products, Inc.

THE ELECTRONIC DEFENSE laboratory of Sylvania is a quick reaction facility. We are concerned with producing reliable equipment in as short a time as possible. This means that the special parts going into such equipment must be created practically on demand. The creation of some of these special parts is the subject of this article.

Experience shows that the simplest approach is often the best. In an analysis, this consists of starting with the basic concepts and the requirements of a problem and then stopping when the needs have been determined. The analysis should not be developed further to derive costly generalities. This only fills the background with so many details that the foreground goes underground.

A formal education in engineering has a tendency to teach the derivation of complex generalities. Quite often the impact of this teaching is so great that the engineer attempts to solve a practical problem through the use of a general equation, rather than by a logical method based on understanding. There is then no feeling for the problem and time is lost in making mistakes. This is called "getting experience." I wish to emphasize that the use of elegant modern techniques should not be considered necessary as they are not always the only way to get answers.

Let us consider a problem using equal lengths of transmission line connected in such a way as to form a directional coupler. A directional coupler has the property of directing power from one input into only two of three possible outputs. There are many forms of directional couplers. We will restrict ourselves for the moment to a two-branch type.

There are two basic concepts necessary to analyze this problem. One is due to Kirchoff and is the law stating that the sum of the currents entering a junction is equal to the sum of the currents leaving the junction. The other consists of the telegraphers' equations which show how the current and voltage vary along a transmission line.

Figure 1 shows how these concepts are applied to a simplified diagram of the directional coupler. Kirchoff's law of currents is used at each junction marked "k." The telegraphers' equations are used to transform the currents and voltage at any one junction to the current and voltage at the next junction, proceeding in the direction of the arrows. These two processes provide all the answers in a general form if required.

There are modern matrix techniques to do this identical problem. There is no need to use such techniques since their use requires special training and since the modern processes do not save time in this case.

Although it is possible to obtain general solutions by using Kirchoff's law and the telegraphers' equations, it is not necessary to do this either. The conditions of a specific problem can be applied at each junction at the start. The successive formulas then remain simple and the answers are obtained directly.

Some of the special components, which have been built with the aid of the described technique, are shown in the following figures.

The first few figures show a variety of filters. These filters are generally used in receivers to separate desired signals from unwanted signals. Different types of separation are possible.

The filter in Figure 2 is a band-pass filter. This filter accepts only a predetermined band of frequencies and rejects those signals on both sides of this pass band. Two adjacent arms form one section of the filter. Six sections are used to increase the rejection of the unwanted signals and to improve the demarcation between the wanted and unwanted signals. Either end may be used as an input.

The filter in Figure 3 is called a separation filter. The input will accept desired signals over a particular pass band and will separate these into two groups. One group containing all the high frequency signals will appear at the right end output. The low frequency signals will appear at the left end output. The separation between the two groups is sharp.

Figure 4 shows several other filters. The upper one is a low pass filter with the cover removed to show the internal construction. The function of this unit is to pass all frequencies lower than the cutoff frequency and to reject the frequencies higher than cutoff. One section of the filter consists of an inductive length of line plus a capacitive length of line. Again, several sections are used to improve the cutoff and rejection characteristics.

The other units shown are coaxial type band-pass filters which operate in different portions of the frequency spectrum.

Figure 5 shows yet another filter. It is a band-pass type made of strip line. It too consists of a number of sections, plus end matching sections to improve the performance at the edges of the pass band. The short stubs at one end prevent possible responses in the stop band. The corregations along one edge insure a good ground connection and hence good performance in the pass band.

Figure 6 shows performance curves of some of the filters illustrated. Two features of these curves are of importance. One is the steep slope occurring at the edge of each pass band and the other is the low pass band loss associated with every filter. Although we have used six or more sections in each filter, the loss incurred is always less than one db. This is an exceptional characteristic of all the filters we have built.

Figure 7, the next component shown (with the cover off) is a 90-degree differential phase shifter. This component

takes power from an input and splits it into two equal parts. The power appearing at one output is delayed by a constant amount with respect to the other. The compensating network maintains this differential over a two to one frequency range. A stepped transformer is used at the input to provide a good match at all the frequencies in the pass band.

Figure 8 shows a three-branch directional coupler. (A branch is a connection between adjacent lines.) This coupler has the same properties as the two-branch coupler shown in simplified form in Figure 1. Power entering any terminal is directed to only the two opposite terminals. The purpose of this coupler is to permit feeding different signals into adjacent terminals and into common loads without having interference between the sources of the signals. It is an important component with many uses in the field of electronics. Three branches are used in this case to improve the performance over a wide frequency range.

In conclusion, it should be emphasized that the components shown were designed and built by personnel who had no prior experience with the particular circuits used. Generous applications of care and common sense were used to make the theoretical approach practical. Some of the units performed exactly as required the first time they were tested. Moreover, the performance is equal to, or better than, that of contemporary art. Since deliveries were better than competitive commercial suppliers, the cost in engineering was small.

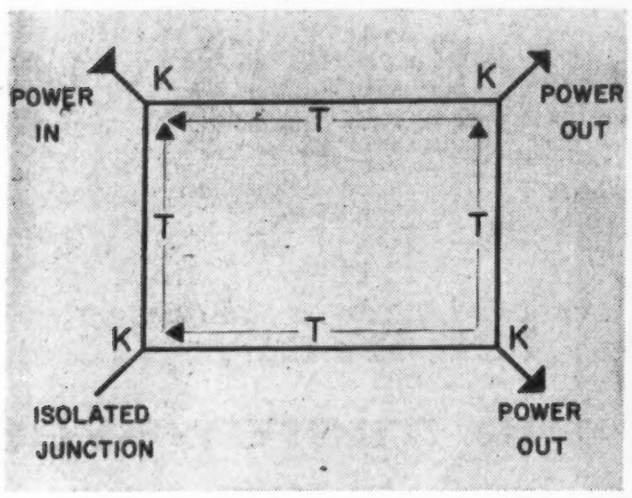


Figure 1: Application of concepts

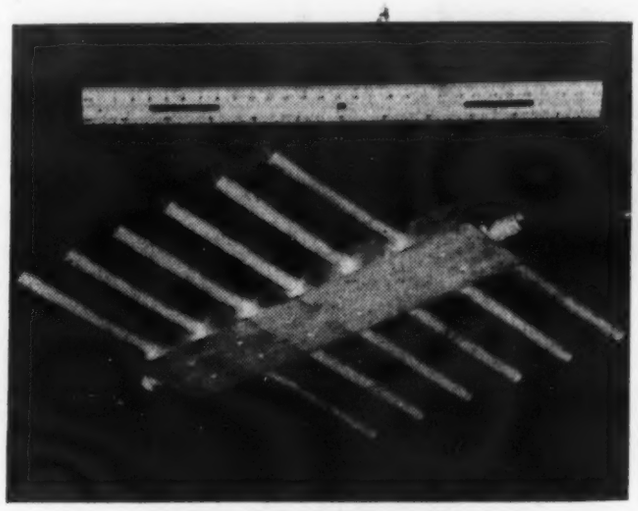


Figure 2: Band-pass filter

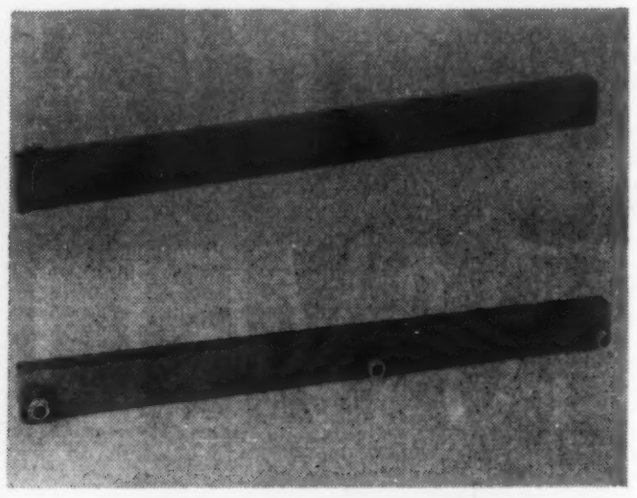


Figure 3: Separation filter

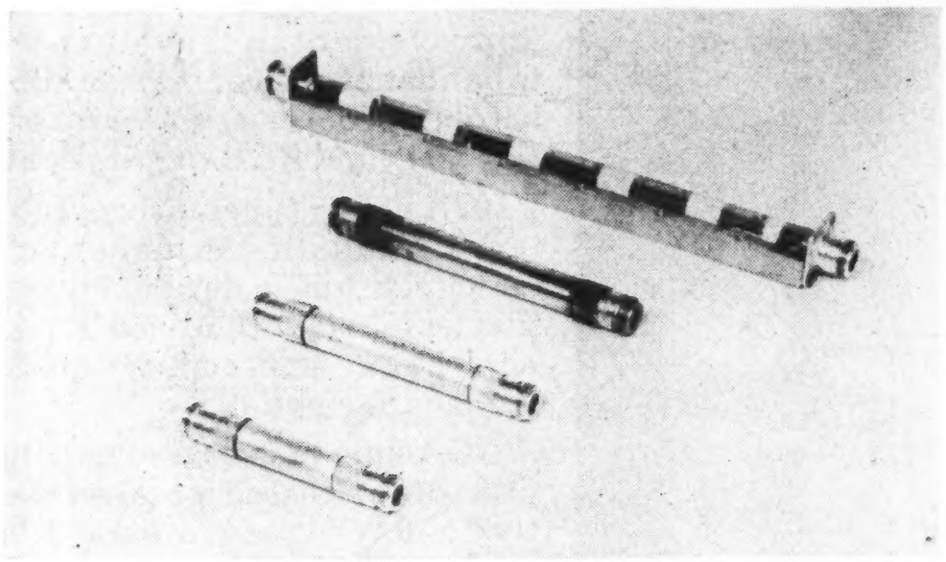


Figure 4: Low pass and band-pass filters

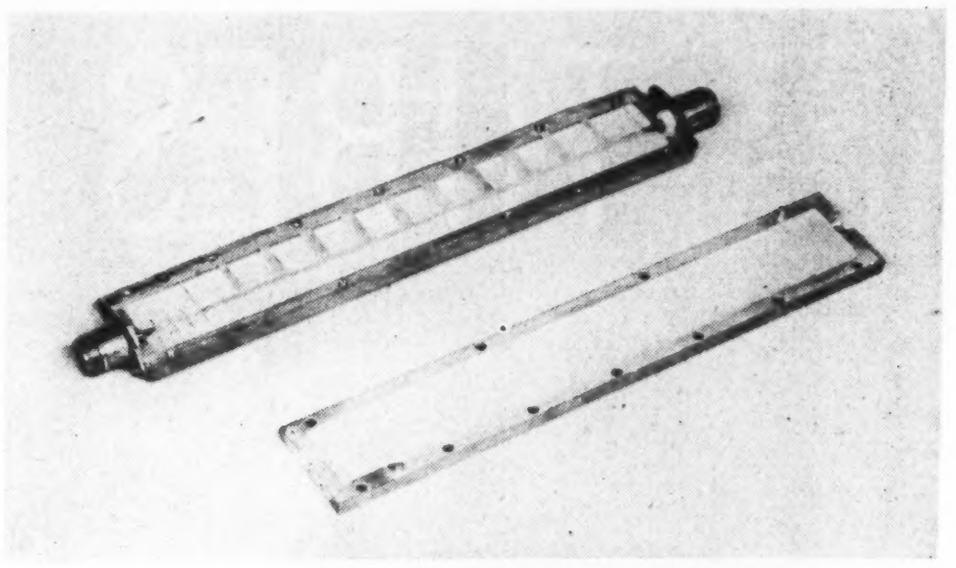


Figure 5: Stripline filter

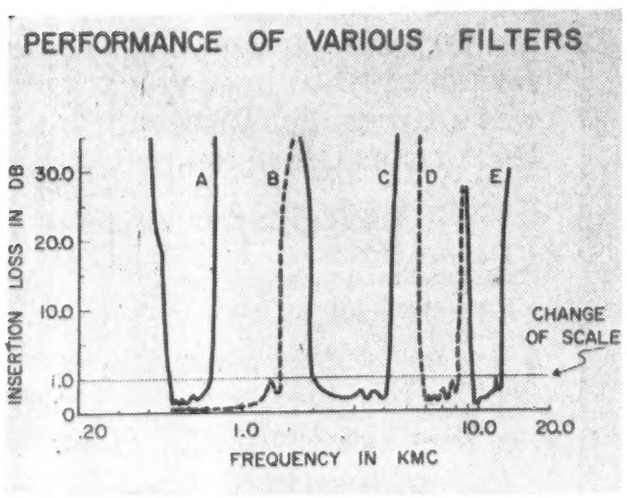


Figure 6: Performance curves

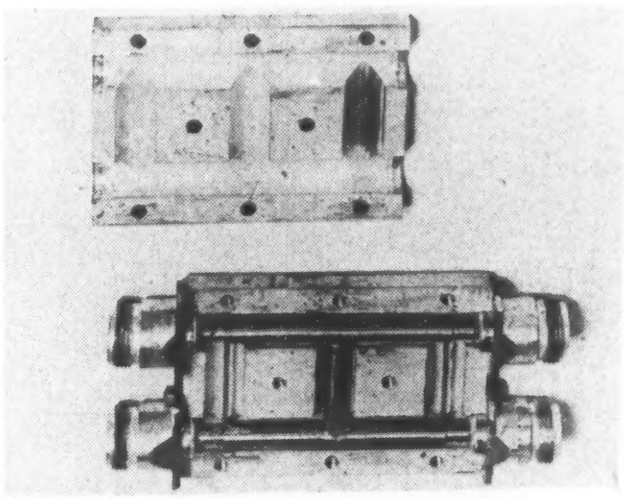


Figure 7: Differential phase shifter

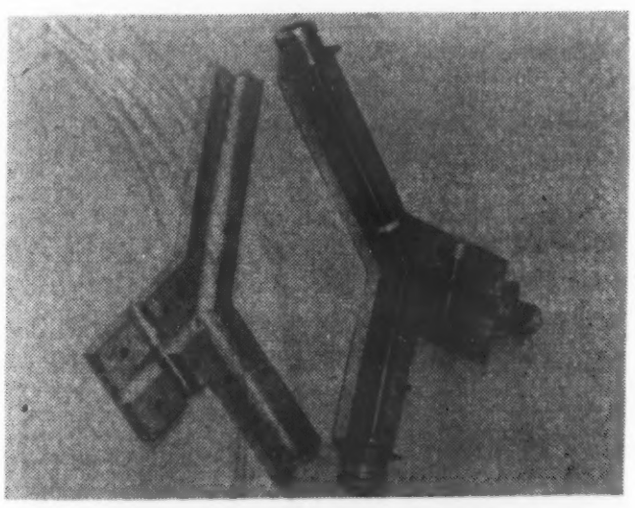
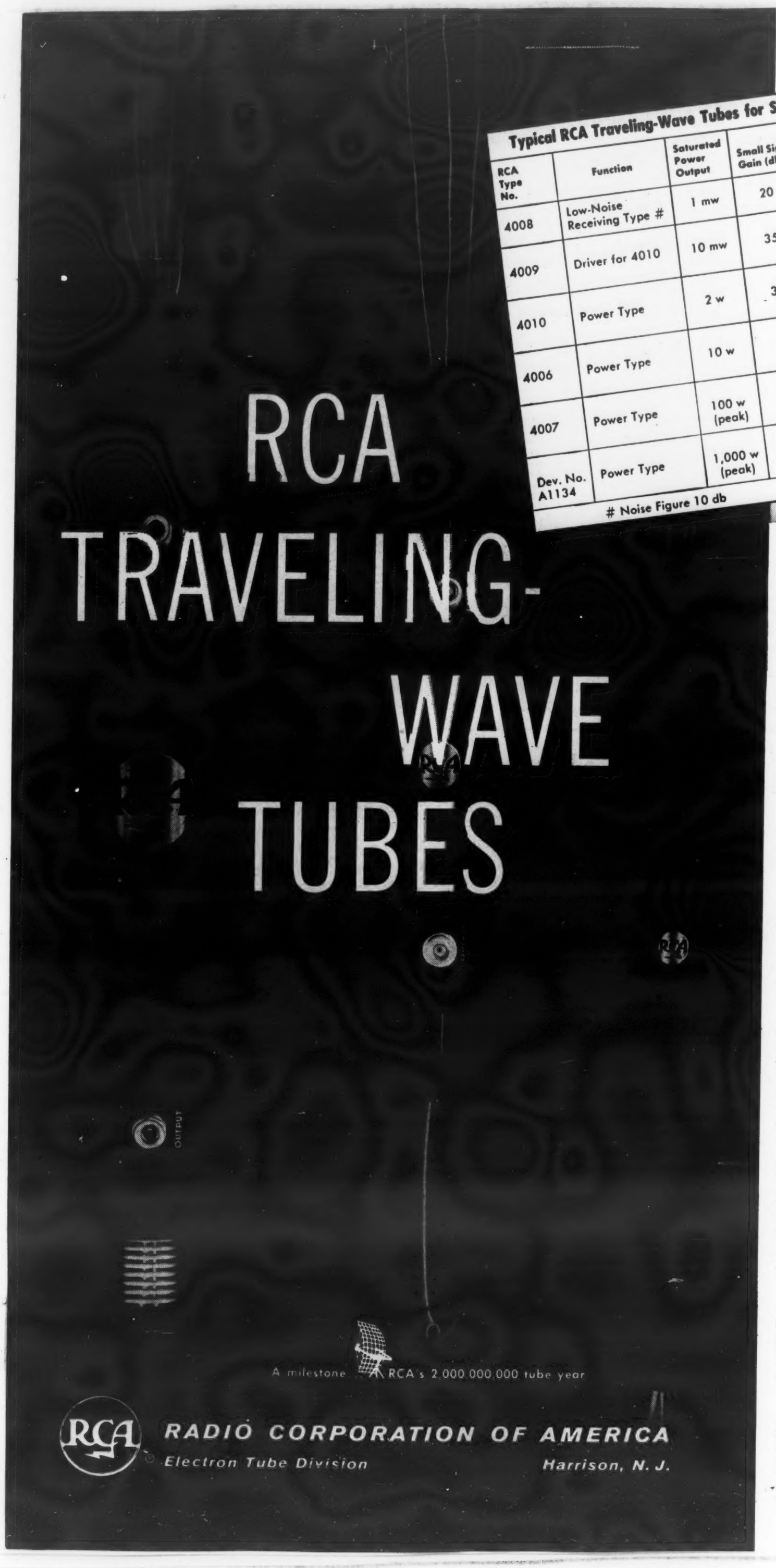


Figure 8: Three-branch coupler



Typical RCA Traveling-Wave Tubes for S-Band (2000 to 4000 Mc) Operation

RCA Type No.	Function	Saturated Power Output	Small Sig. Gain (db)	Focusing Method	Dia (in.)	Length (in.) Approx.	Weight (lb.)
4008	Low-Noise Receiving Type #	1 mw	20	Light-Weight Solenoid*	*2¼	*16	*10
4009	Driver for 4010	10 mw	35	Integral Periodic Permanent Magnet	1½	14	1½
4010	Power Type	2 w	35	Integral Periodic Permanent Magnet	1½	18½	3½
4006	Power Type	10 w	25	Integral Periodic Permanent Magnet	1½	20	12½
4007	Power Type	100 w (peak)	30	Integral Periodic Permanent Magnet	2½	22	15
Dev. No. A1134	Power Type	1,000 w (peak)	30	Integral Periodic Permanent Magnet	2½		

Noise Figure 10 db

* Including solenoid available separately

for every job in microwaves

Pacing the fast-moving advance ments in tubes for microwave RCA offers designers a comprehen sive line of low-noise and powe traveling-wave tubes—for any ap plication in the L, S, C, and X bands. These tubes feature a majo improvement in traveling-wav tube manufacture: *high uniform ity of characteristics maintaine through rigid RCA quality contro*

RCA *power types* incorporate in tegral periodic-permanent-mag netic focusing—a design advantag that eliminates the need for sole noid power and reduces packag size and weight.

RCA *low-noise receiving type* provide increased receiver sensi tivity across octave bandwidths And they are "tailored" to meet th requirements both in new equip ment designs and in *modernizatio of existing microwave systems!*

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- 1625 "K" St., N. W., Washington 6, D.C. DIstrict 7-1260

INDUSTRIAL PRODUCTS SALES

- 744 Broad St., Newark 2, N.J. HUmboldt 5-3900
- Suite 1154, Merchandise Mart Plaza Chicago 54, Illinois WHitehall 4-2900
- 6355 E. Washington Blvd., Los Angeles 22, Calif. RAymond 3-8361

MAGAZINE ARTICLES ABSTRACTED ELECTRICALLY A system, called Auto-Abstract, enables a data processing machine, such as an IBM 704 computer, to read magazine articles, select excerpts and then write an abstract. The complete text of an article is first transcribed onto a magnetic or punched tape in a code. The machine analyzes the text word by word and then determines the relative degree of significance of the word. Next, each sentence is graded as to its importance and sentences scoring highest are automatically extracted from the text and printed out. The system promises to be particularly helpful in scanning and excerpting scientific papers and foreign language articles.

AERIAL PHOTO CAPTION WRITER An automatic caption writer for use by the U. S. Air Force in aerial photography has been developed by Federal Telecommunication Laboratories, research division of the International Telephone and Telegraph Corporation. The invention, known as the Digital Data Recording Device, records in coded-dot form the location, speed, altitude and other pertinent data directly on the photographic film as the camera plane speeds over its target. During development of the film, a ground-based portion of the recording device decodes and prints the data beneath the picture.

TRANSISTORS CLASSIFIED AUTOMATICALLY A machine built by General Electric Company can replace an entire line of individually operated test stations and can process transistors at the rate of 1200 per hour. The automatic transistor classifier characterizes and sorts the transistors, eliminating the rejects. As many as ten different types of transistors can be separated on the basis of up to sixteen tests which the machine performs. The changes in specifications can be read into the machine by means of a push button in most cases, and simple plug-in components and shaft adjustments for others.

TRAFFIC REMEDY A radio traffic control system by Motorola, Inc., provides a flexible and reliable method of centrally controlling and synchronizing traffic lights. The system works from a central programmer and the information from this programmer is translated into tone codes which are radio transmitted to FM receivers at each intersection where a decoder interprets the tones to set up the desired change in the local controller. The system can handle up to 1000 intersections with 16 control changes per intersection to regulate the flow of traffic signals to meet rush-hour conditions, changing weather or other problems in the traffic situation.

— GENERAL —

EXPLORING THE UNIVERSE Next fall, scientists at Jodrell Bank, England, will endeavor to bounce radio beams off the surface of Venus, the planet closest to the earth (25,750,000 miles away). The difficult experiment will commence as soon as the powerful new transmitter, being built at Manchester University, is fitted to the giant 250-foot diameter radio telescope. The effective power output of the new transmitter is 3000 times stronger than the average military radar set. The Jodrell Bank radio telescope has the largest steerable aerial in the world.

EVENTS OF INTEREST:

May 20: Noted economists and spokesmen for science and business will meet at the Shoreham Hotel in Washington, D.C., to discuss "Research and Development and Its Impact on the Economy." National Science Foundation is sponsoring the conference. James R. Killian, Jr., Special Assistant to the President for Science and Technology, will be the dinner speaker.

June 2-7: Solid-state physics is the theme of the 16-nation congress scheduled to meet at the Universite Libre, Paris, France. The congress is being organized by the Postal and Telecommunications Group of the Universal and International Exhibition of Brussels 1958 under the direction of Dr. M. C. Desirant.

June 4-6: The Twelfth Annual Convention and Exhibit of the Armed Forces Communications and Electronics Association will be held at the Sheraton Park Hotel, Washington, D.C. Convention theme is "The Trine of Progress: Research, Development, and Technology."

June 9-12: The Conference on Materials Handling is being sponsored by the American Society of Mechanical Engineers and will be held at the Public Auditorium, Cleveland, Ohio, concurrently with the National Materials Handling Exposition.

June 11-14: The National Society of Professional Engineers will hold its annual meeting in the Chase-Park Plaza Hotels in St. Louis, Missouri.

June 16-18: The 2nd National Convention on Military Electronics will be held at Sheraton Park Hotel, Washington, D.C. The theme for the convention is "Missiles and Electronics—1958" 'Ad Astra Per Aspera.' PGMIL (Professional Group on Military Electronics) of IRE is sponsoring the event.

TOUCHDOWN...*EVERY THIRTY SECONDS*

The weather has closed in. You peer out the window and see nothing – perhaps not even the wingtip.

You are orbiting. "Stacked" over the airport. Waiting your turn to land.

"We will land in 12 minutes"

The Captain's reassuring words come over the intercom. "We will land in 12 minutes."

Now you are being brought down in easy stages–safely –over the Outer Marker Beacon . . . the Middle Marker . . . the Inner Marker . . . then *touchdown* . . . on the runway.

Every 30 seconds, somewhere in the free world, a plane is landed safely by "ILS," the Instrument Landing System developed by IT&T, and installed in every major airport here and abroad.

Air passengers relax–pilots too!

Air passengers everywhere know this feeling of security.

The pilot likes it too. Because he controls the landing at all times. Once he is on the glide-path he needs no further instructions – nothing except the electronic information he sees before him on the instrument panel, and the meaningful "beeps" in his earphones.

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IT&T has long been a pioneer in radio aids to air navigation. IT&T laboratories developed the first radio compass. The first distance-measuring equipment. For the Navy and the Air Force they developed and perfected TACAN (Tactical Air Navigation), the system that gives military aircraft their pinpoint position in the air–at every instant of flight.

Last year the Civil Aeronautics Administration accepted VORTAC – an application of TACAN for all civil aircraft. The CAA has awarded to IT&T the contract to build 132 VORTAC ground stations throughout the U.S. Thanks to VORTAC the nation's airways will soon be ready for the fastest jet transports.

The next time you are aloft in bad weather . . . remember IT&T and relax. Your skilled pilot will bring you to a smooth touchdown . . . with "ILS."

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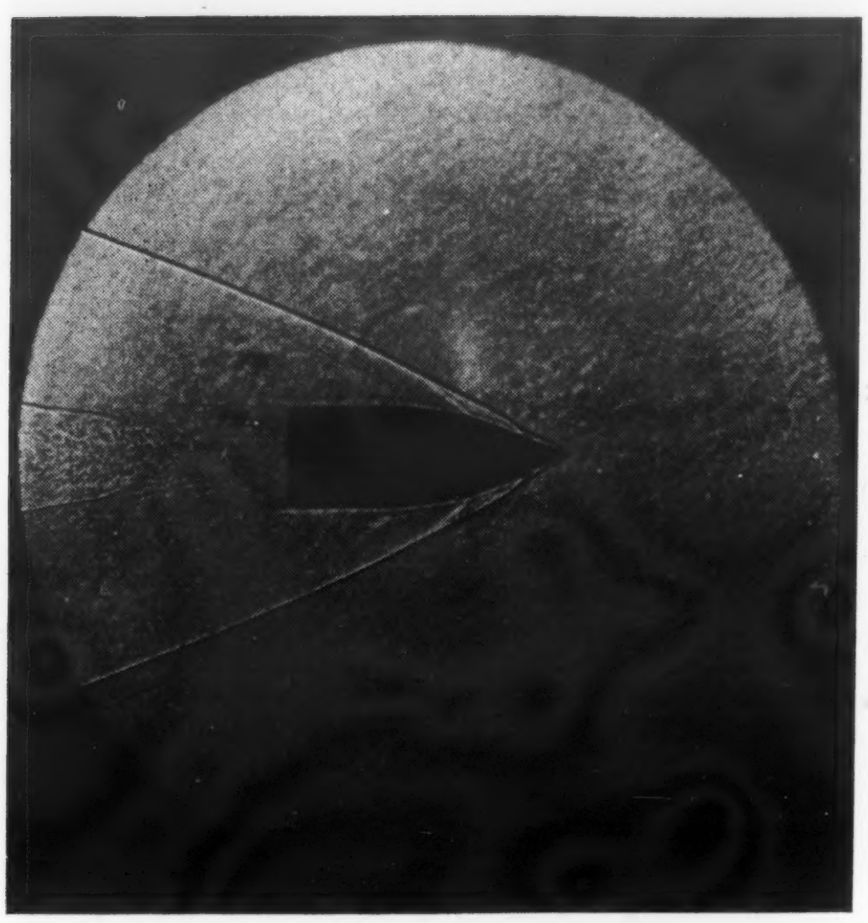
photoprogress



Shadowgraph of a .22 caliber bullet traveling at 4100 feet per second clearly shows the shock waves with no blurring visible. This was taken with a synchronized spark light source of .012-inch diameter and a 2-inch-square Kerr cell operating at an exposure of .01 microsecond. The Mach lines visible at the cone section of the bullet were caused by .002-inch scribe marks.

by FRANK SMITH

SIGNAL PHOTO EDITOR

Super Fast Electro-Optical Shutter

Periodically, there are announcements of shorter and shorter exposure times being obtained in the field of high-speed photography. One of the latest announcements concerning equipment for this purpose is that of Avco Mfg. Corp., Research and Advanced Development Div., Lawrence, Mass. They have reported an exposure time of .01 microsecond achieved with their Kerr cell electro-optical shutter and an improved pulse generator circuit. The complete shutter, redesigned into a compact 12″ x 12″ x 5″ package is now being marketed by them. The package includes the pulse generator and a specially designed spark gap to provide the required driving signal. The unit operates from an external 0-50 kilovolt power supply and a low-voltage trigger source.

The two-inch-square shutter has been applied to aerodynamic simulation studies of long-range missile re-entry problems. Exposure times in the range of 10^{-8} to 10^{-7} are required to prevent image blur in Avco's work with scaled-down projectiles fired at very high velocities in its ballistic range.

Key to Avco's new technique is the pulse generator, which consists of RG 8/U coaxial cable and the spark gap. The Kerr cell is connected directly across the load resistor on the transmission line and does not require an impedance watching network or pulse transformer.

The electric field needed to produce phase rotation of the electromagnetic light vector as it passes through the nitrobenzine-filled cell lies between 10 to 15 kilovolts per centimeter. Thus a pulse generator for a 5 cm aperture must deliver a pulse of 50 to 75 kilovolts to the Kerr cell plates. Exposure time can be accurately varied from .01 microsecond to .1 microsecond by changing the length of the transmission line used in the pulse generator. The waveform of the exposure characteristic is nearly that of a square wave.

The spark gap used on the pulse generator is designed to minimize effects of corona leakage and atmospheric variations on the trigger characteristic. Using a simple pulsing circuit consisting of a capacitor discharging through a thyratron tube into the primary of a 35:1 step-up pulse transformer, the gap can be triggered reliably with a jitter of less than 0.1 microsecond.

This spark gap may be modified for shadowgraph, or Schlieren photographs, to provide a point source that is fully synchronized with the opening of the Kerr cell. This eliminates the need for precision delay units and eases jitter requirements for spark-gap triggering.

With a pulsed light source, reflected light photographs of a standard resolution chart have been obtained on Polaroid Type 44 material at a 10^{-8} second exposure time. Resolution tests have also been made at 10^{-7} seconds on Kodak Royal-X panchromatic film. With normal development, these tests yielded a resolution of 45 lines per/mm.

Original work on the pulse generator was performed at the Los Alamos Scientific Laboratory under the auspices of the Atomic Energy Commission.

Photographic Aspects of IRE Convention

Being increasingly aware of the invasion of electronics into photography and photography into electronics, your photo editor decided to investigate this phase personally, even if only briefly, and to give our readers some highlights of developments in this field.

Electronics-wise, 'Greatest Show on Earth' is no mere figure of the imagination. It is. When one realizes that some 55,000 people viewed the 17,000 items on display by nearly 1000 exhibitors in a line of booths 2½ miles long, one can visualize what an immense show this really was. Here are some of the new developments in photographic equipments.

• One of the outstanding items on display was the CBS Type 5BYP5 Five-Inch Ultra-High Resolution Photo-

graphic Cathode-Ray Tube of CBS-Hytron, Danvers, Mass. The tube can be combined with photographic systems to store and transmit pictorial information. The tube has a resolution of 6000 TV lines and combines this resolution with high contrast. This resolution figure is uniform throughout the screen area. The tube is especially designed for highly detailed photographic reproduction use.

• Another item of considerable interest to photographic instrumentation engineers was the new Beattie Oscillatron Camera with Polaroid back for oscillographic recording. With this camera, one can get one-to-one presentation or up to ten exposures on a single frame by a simple adjustment. Other features of the camera are: f/1.9 lens and shutter speeds from 1 sec. to 1/100 sec., time and bulb.

The camera is manufactured by Beattie-Coleman, Inc., 1000 N. Olive St., Anaheim, Calif.

• Attracting much interest was the infrared instrumentation display of Barnes Engineering Co., Stamford, Conn. Of particular note was their infrared camera Model 1-8A. Although time prevented a view of the complete instrument, here are some details concerning this unusual device, which is designed to meet the special temperature-measuring requirements of laboratory, field, mill and factory. Using high-resolution scanning and advanced radiometric techniques, the camera makes thermographs (thermal photographs) depicting temperature distribution over extended areas. It is not dependent on external sources of illumination or irradiation, but utilizes only the infrared energy naturally radiated by all objects. Those interested in more complete details covering the camera should request Bulletin 1260 from the company.

• Some 300 technical papers were delivered at 55 sessions. Among those of photographic interest may be included one entitled "Millimicrosecond, Wide-Aperture, Electro-Optical Shutter," by Joseph A. Hull of Avco Mfg. Corp., Lawrence, Mass. This paper covers a 2 x 2-inch aperture Kerr Cell electro-optical shutter to provide exposure times in the range of 10^{-8} to 10^{-7} second.

Another paper entitled, "A Xerographic Cathode-Ray-Tube Recorder" was presented by H. H. Hunter, O. A. Ullrich and L. E. Walkup of Battelle Memorial Institute, Columbus, Ohio. This paper described research on a high-speed, direct-writing, cathode-ray-tube recorder using xerographic techniques to produce the permanent image, and covers three methods of direct recording which were studied. In the first method, high-energy electrons in the beam of the cathode-ray tube were transmitted through a thin window in the face of the tube and collected on an insulating sheet outside the tube. In the second method, electrons from the beam of the cathode-ray tube are deposited on the inner surface of an insulating window in the face of the tube. The third, and most promising method of recording cathode-ray images involves depositing electrical charges from the electron beam on a row of small conducting pins projecting through the face of the tube.

A paper entitled "Recent Developments in Shaped Beam Display and Recording Techniques," presented by R. M. Peterson and R. C. Ritchert of Stromberg-Carlson Co., San Diego, Calif., covered recent developments which have resulted in considerable improvement in such shaped beam tube characteristics as character selection and deflection, phosphor and matrix resolution, tube length and dynamic control of character size. These features have been incorporated in a new series of experimental tubes ranging in size from 1½" to 19". Equipment has been developed combining these tube capabilities with either photographic or dry printing xerographic recording techniques and accepting techniques either on line or tape inputs.

U. S. Army Signal Corps Photographic Developments

"Folded Optics" Long-Range Infrared Reconnaissance Camera

A far-sighted, sharp-eyed photo scout designed to snap close-up pictures of battle action thirty miles away and provide a picture in 60 seconds by using Polaroid film has been developed by the U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., and the Kalart Company, Inc., of Plainville, Connecticut.

The camera, which is built around a powerful 100-inch haze-cutting infrared lens, easily photographs objectives far out of the range of standard Army cameras. The camera can pick out a jeep at six miles, spot a soldier at two miles, and show detail on his face at half a mile. At 30 miles, it can provide valuable photos of enemy installations and troop movements and can keep an eye on the enemy, even when aerial photography is impossible.

A feature of the camera, which uses standard 5" x 7" film as well as Polaroid, is its optical system which, with internal mirrors, reflects the light in a "Z" path, eliminating the long, cumbersome extension tube needed in previous experimental versions of the camera.

In addition to its vital role in military reconnaissance, the new long-range camera could be used commercially to take close-up pictures of inaccessible and distant areas for newspapers and magazines. Teamed with television, it could scan large tracts of woodland to detect and help fight forest fires and aid in disaster rescue operations. It also promises to add a new dimension to wildlife photography, capturing shots of elusive game from a vantage point several miles away.

With its 40-pound lens, the camera's total weight is about 150 pounds. Fold-out handles allow two soldiers to carry it like stretcher bearers. It is ready for action in minutes.

SIGNAL's cover, picturing the camera described above, was selected to pay tribute to Armed Forces Day. It represents communications-electronics progress in equipment employed by our modern military forces.

System for Synchronizing Magnetic Tape with Perforated Motion-Picture Film

An interesting development for synchronizing magnetic tape with perforated motion picture film is described in the *Journal of the SMPTE* for February 1958 by Edward P. Kennedy, motion picture engineer of the U. S. Army Signal Engineering Laboratories at Fort Monmouth, N. J.

As is well known, the method of utilizing synchronously driven toothed sprockets engaging complementary film sprocket holes for sound-film production is an old technique.

With the introduction in 1947 of cellulose acetate sound magnetic tape, which has a thin and easily torn base, sprocket holes obviously were out of the question. Kennedy has developed a system which employs magnetic equivalents of sprocket holes recorded along the tape simultaneously with the recorded sound and at the exact time of frame exposure in the camera. These "latent magnetic sprocket holes" are later reproduced to serve as a master speed control device to govern the speed of the picture film through the playback equipment.

A microphone and a synchronously driven camera and

(*Continued on page* 43)

Whenever scientific work calls for the recording of images from instruments special characteristics are called for in recording films. That is why Ansco produced Ansco Recording Film FPC 42-1. Here is a blue sensitive emulsion resolving 100 lines per millimeter that may be rapid processed at high temperatures in *seconds!*

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Photoprogress (*Continued from page* 40)

tape recorder comprise the taking unit. Normally the camera exposes the film at 24 frames per second and the tape recorder, running simultaneously, records both the instantaneous power line frequency and output of the microphone onto the tape as dual tracks which do not interfere with each other. When the tape is played back with the film, the sound track on the tape is reproduced normally and the tape track containing the recording of the power-line frequency is channeled to serve as the master speed control for the picture projector.

In addition to its motion picture tape-synchronizing application, it appears that the method is capable of being developed into an accurate, and infinitely variable, speed control for A-C motors, an application which is believed to be unique.

A U. S. Patient No. 2,822,722 covering the system was issued to Kennedy on Feb. 11, 1958 and assigned to the U. S. Government.

Ultrasonic Agitation of Photographic Processing Solutions

A new use for ultrasonics—high frequency sound waves—has been disclosed in a paper written by A. L. Dighton and W. D. Stump of the Dow Chemical Co. and published in a recent issue of *Nondestructive Testing* (Jan.-Feb., '58).

Since this is a relatively new method for agitation of photographic processing solutions, it may be of interest to describe and discuss the equipment used and some of the results obtained.

The ultrasonic equipment used by Dighton and Stump in their tests included a Sonogen Model AP-25, 125-watt output agitator, the agitation transducers of which were approximately 8 inches by 2½ inches by 2½ inches in size (Sonogen Type LF-15). These transducers were submerged in the developing tank of a Model 30 Pako Filmachine. The authors' note that while the Sonogen Ultrasonic Unit was not designed specifically for this particular purpose, nevertheless, satisfactory set-ups were obtained.

Although several other films were tested, this paper covers only the results obtained with Kodak AA&K and DuPont 506, exposed to Cobalt-60.

The object which was radiographed was a 6-inch square block of lead, ¾ inch in thickness in which three steel penetrameters, 0.030 inch, 0.065 inch and 0.080 inch were placed near the center. The images on these films were processed by ultrasonic agitation and showed no decrease in quality as compared with routine processed film.

The conclusions of the authors are that the results obtained by ultrasonic agitation indicate that it can be quite beneficial in processing film that must be better than routine quality as to film streaking.

Futhermore, it appears that film processed by ultrasonic agitation is practically free of the streaks encountered with automatic film processing, providing the transducers are properly arranged.

Other benefits that may result are: some cleaning of the processing tanks by the ultrasonic waves; possible shorter radiographic exposures due to the increased densities available in ultrasonic processing and greatly extended life of the processing solutions.

From the above, it appears that ultrasonic agitation of film possesses considerable merit and it would not be surprising at all if some enterprising manufacturer came forth with a unit designed specifically for the purpose.

The above work was performed under U. S. Atomic Energy Commission Contract AT(29-1)-1106.

Personnel Available

As a service to AFCEA members, SIGNAL will make space available in this column for those members who are interested in employment in the communications, electronics and photography industries. Any member is entitled to three insertions in the magazine on a space available basis, free of charge. Please limit your notice to 5 lines. In replying, employers are asked to address: Box ....., SIGNAL, 1624 Eye St., N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

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SOUTH TEXAS: Pres.—Col. Will D. Joslin, SigSec, Hq. 4th U. S. Army, Fort Sam Houston, Tex. Sec.—Maj. Vincent Grzegorowicz, 634 Infantry Post, Fort Sam Houston, Tex.

SOUTHERN CALIFORNIA: Pres. — Lester R. Daniels, Daniels Engineering, Inc., 5244 Van Nuys Blvd., Van Nuys, Cal. Sec.—Col. Frank J. Shannon, Sr., Packard-Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64, Calif.

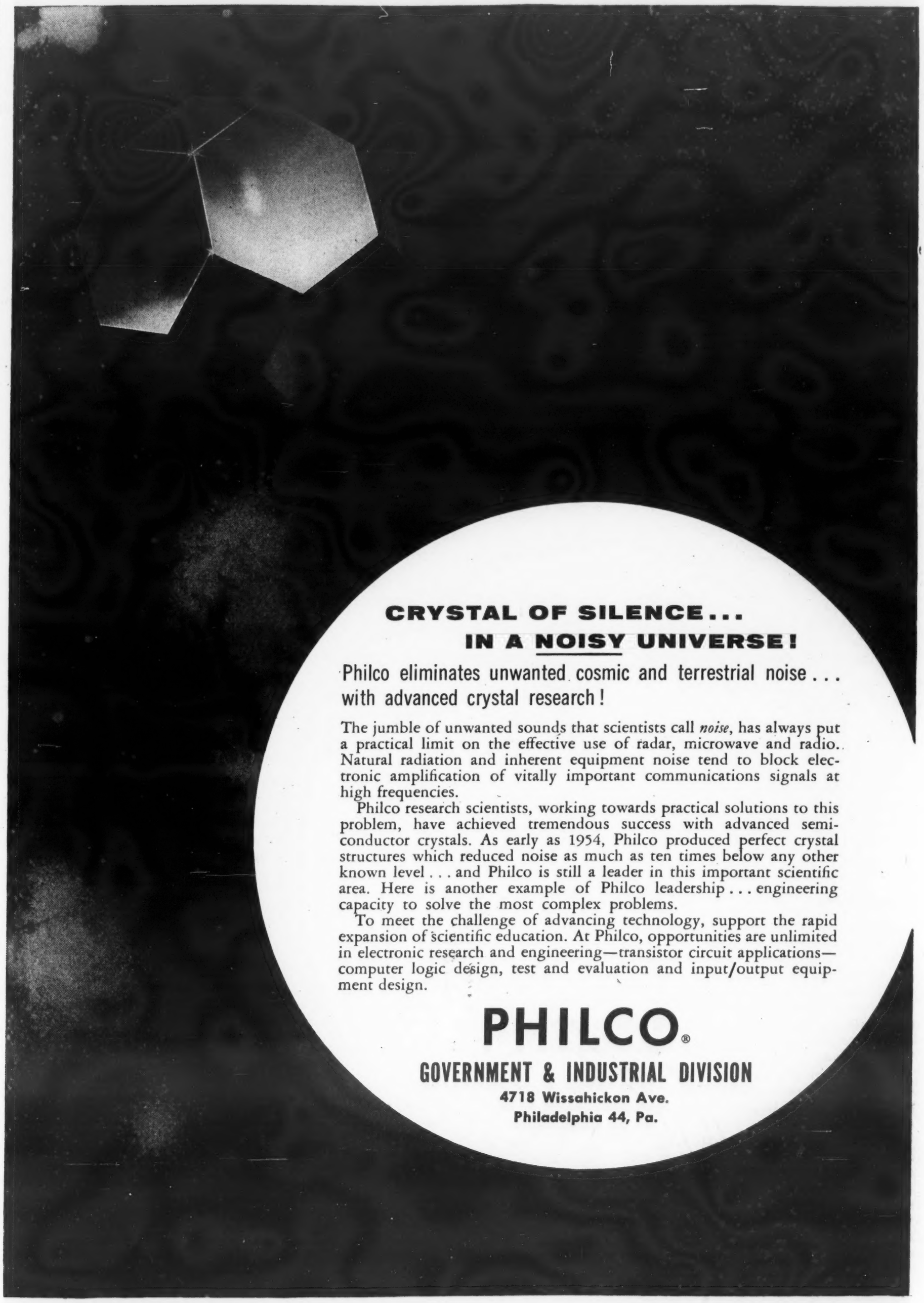
SOUTHERN CONNECTICUT: Pres. — Edwin B. Hurley, So. New England Tel. Co., Box 1562, New Haven. Sec.—J. A. Leopold, Dictaphone Corp., 375 Howard Ave., Bridgeport.

SWITZERLAND: Pres.—Capt. Gerald C. Gross, USNR, Intl. Telecommunications Union, Geneva. Sec.—Robert V. Lindsey, Intl. Telecommunications Union, Geneva.

TINKER-OKLAHOMA CITY: Pres.— Delbert F. Cravens, Southwestern Bell Tel. Co., 405 No. Broadway, Oklahoma City. Sec.—Lt. Col. Albert A. Rudd, 1800 AACS Wing, Tinker AFB, Okla.

TOKYO: Pres.—Col. Thomas W. Riley, Hq. USARJ Sig. Off., APO 343, S. F. Sec.—D. A. L. Hughes (Philco), Hq. USARJ Sig. Off., APO 343, S. F.

WASHINGTON: Pres.—L. Harriss Robinson, Motorola, Inc., 1145 19th St., N.W. Sec.—John R. O'Brien, Hoffman Laboratories, Inc., 1625 Eye St., N.W.



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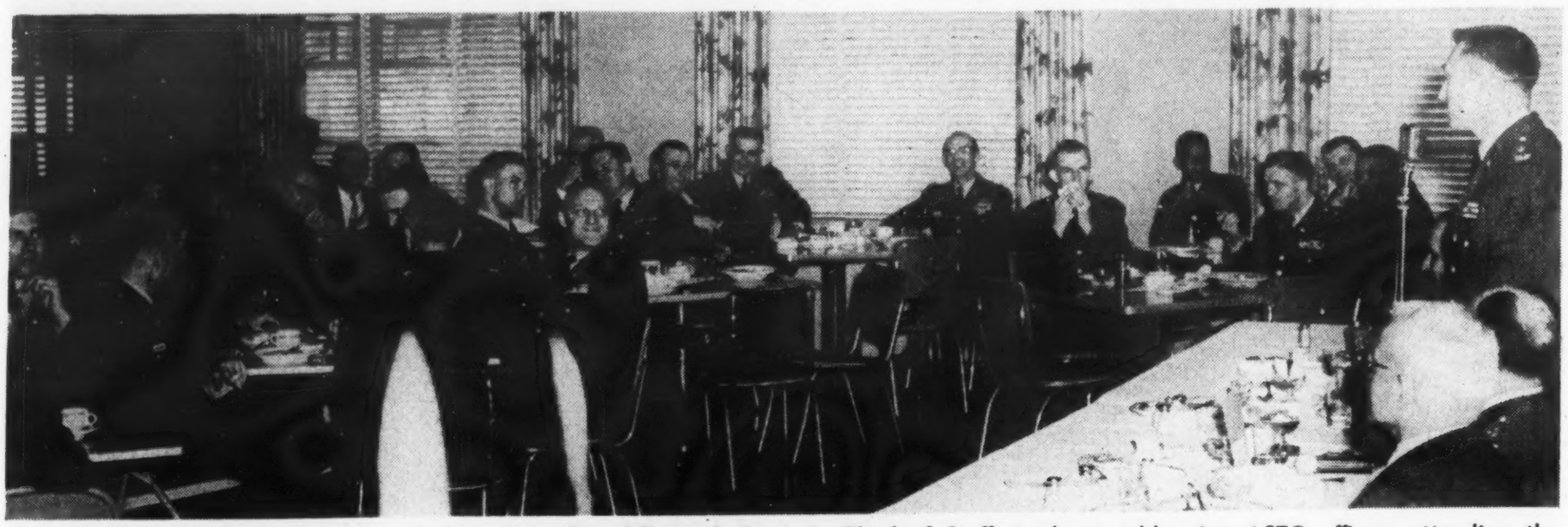
Chapter News



Augusta-Fort Gordon—Col. Erling J. Foss, Army Signal Training Center's Chief of Staff, is shown addressing ASTC officers attending the March 20th luncheon-meeting of the chapter.

Atlanta

Rear Adm. Henry C. Bruton, Director of Naval Communications, was guest speaker at the chapter's March 18th meeting. His subject was "Some Problems of Naval Communications and How We Are Attempting to Meet Them." Admiral Bruton's speech is to appear in the June issue.

During the business session, the following new officers were elected for the coming year: president—W. B. Bryan, Southern Bell; first vice president—A. E. Arnold, Western Union; second vice president—Lt. Col. T. A. Pugh, Headquarters Third Army; third vice president—Lt. Col. L. J. Ross, Atlanta General Depot; fourth vice president—M. S. Hall, Georgia Institute of Technology.

The meeting took place at the Fort McPherson Officers Club, with 130 members and guests present.

Augusta-Fort Gordon

Almost 250 officers of the Army Signal Training Center heard their Chief of Staff, Col. Erling J. Foss, emphasize the importance of AFCEA membership at the March meeting of the chapter. The noon luncheon, attended by virtually all the ASTC officers, was held on March 20th at the Fort Gordon Officer's Open Mess.

Stressing the necessity for the Signal Corps to be aggressively identified with national efforts in the interest of communications-electronics science, Col. Foss pointed out the Association's role in promoting a strong military posture and national advancement. He enumerated the many advantages of an AFCEA membership, especially underlining those gained from the close association of the civilian-military members of the organization.

M/Sgt. Martin L. Jenkins, 1st vice president, presided. Also seated at the head table were Col. Otto T. Saar, Col. John J. Fettig, Col. Charles A. Wingo, and Mr. Tom Rodgers. Col. Saar's imminent transfer overseas was announced and he was given an outstanding ovation by the chapter, which he had served as president during 1955.

Following the meeting several members and guests toured the Army Signal Training Center's television studios.

Baltimore

The March 18th meeting featured a Marine Corps program.

Col. Robert C. Walton, Assistant G-4 (Logistics) Officer at USMC Headquarters, Washington, addressed the chapter on "Communications, Electronics, and the Marine Corps."

Col. Walton is a veteran of 25 years' service in the Marine Corps and has seen duty in the United States, Asia and the Pacific.

The Park Plaza Hotel was the scene of the meeting which was preceded by the usual social hour and dinner.

Central Florida

Maj. Gen. Alvin L. Pachynski, Director of Communications-Electronics, USAF, and a National Vice President of the AFCEA, addressed the chapter's March 7th meeting, at MacDill Air Force Base.

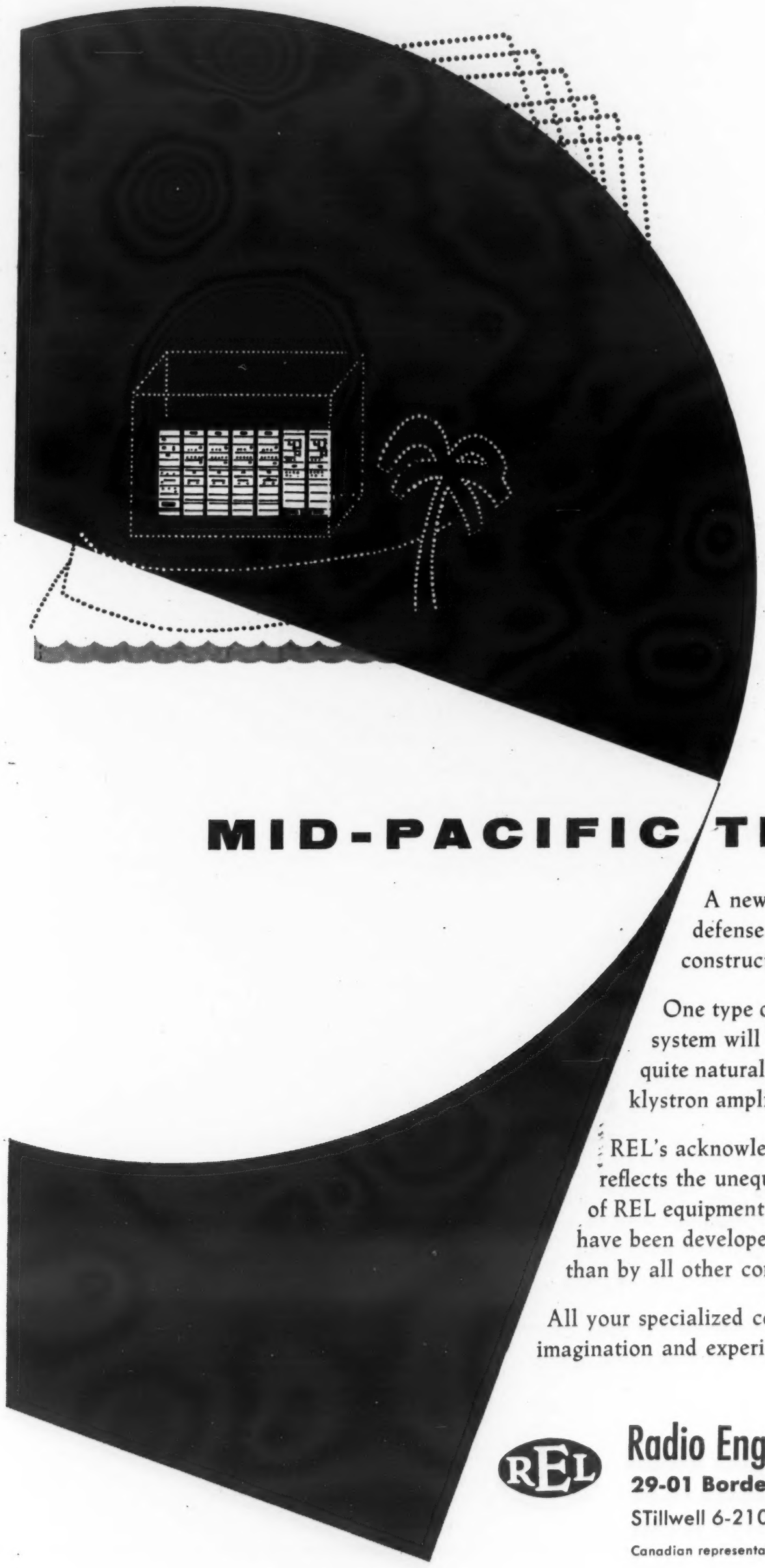
General Pachynski's speech on the DEW Line, together with an Air Force film, gave a comprehensive portrayal of the difficulties encountered and overcome in constructing and installing this Distant Early Warning radar net across the Arctic.

During the meeting, chapter president Willard L. Moor, who is Chairman of the Board of the I-G-E-I Electronics Institute, Inc., in Tampa, presented an honorary degree of Doctor of Science in Electronics Applications Engineering to the General.

Held at the Officers Club of MacDill Air Force Base, the meeting was preceded by a social hour and dinner. A representative group of industry and military personnel were in attendance.

(*Continued on page* 52)

Central Florida—Maj. Gen. A. L. Pachynski, Director of Communications-Electronics, USAF, receives the honorary degree of Doctor of Science in Electronics Application Engineering from Willard L. Moor, chairman of the board, I-G-E-I Electronics Institute and president of the AFCEA chapter. The occasion was the chapter's March 7th meeting which was addressed by General Pachynski.



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1958 **AFCEA** CONVENTION

- **WEDNESDAY**
  9:00 a.m., Presidents' Meeting
  12:30 p.m., Keynote Luncheon *
  2:00 p.m., Panel Discussion **
  6:30 p.m., Reception
  7:45 p.m., Buffet supper
- **THURSDAY**
  9:00 a.m., Council and Directors' Meeting
  11:30 a.m., Tour with Luncheon—Andrews Air Force Base
  6:30 p.m., Reception
  7:45 p.m., Banquet *
- **FRIDAY**
  12:30 p.m., Industrial Luncheon *

*Featuring a distinguished speaker

SHOW HOURS: Wed.-Thurs. 11a.m.-7p.m., Fri. 11a.m.-5p.m.

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SPECIAL TOURS:
White House; FBI; Pan-American Union & Gardens; Aquarium; Wax Museum; Bureau of Engraving & Printing

LUNCHEON & FASHION SHOW

JUNE 4, 5, 6—SHERATON PARK HOTEL

WASHINGTON, D. C.

PROFESSIONAL PAPERS

1. "Facsimile Recording Using Magnetic Tape," by J. Wade Dorsett (Ampex Corporation)
2. "Multi-Company Coordination in Providing Large Communication Networks," by L. S. Whitby (Pennsylvania Bell)
3. "Communications Media for Space Age Systems," by J. L. Ryerson (Rome AFB)
4. "Communications in the Arctic," by J. Krcek (Office of Naval Research)
5. "Military Photography," by Carl Orlando (Signal Corps Labs)
6. "Weather Radar, a Tool for Combat," by D. Swingle (Signal Corps Labs)
7. "Applications of Digital Information Processing Systems in the Future Field Army," by M. Blitz, C. Dixon, H. Young (Sylvania Electric Products, Inc.)
8. "An Automatic Communication Switching System," by R. E. Montijo (Radio Corporation of America)
9. "Channelizing Frequency Modulated Scatter Communication Systems," by T. A. Combellick (Lenkurt Electric Co.)
10. "The Modern Air Force—Its Challenge to Communications & Electronics Research & Development," by Col. Gordon T. Gould, USAF (AF Research & Development Command, Andrews AFB)
11. "The Product Review Program & the Need for It," by W. J. Laverick (Signal Corps Labs)
12. "Value Engineering," by Albert Sikorsky (Bureau of Ships)

(10:00 a.m. to 12:00 noon daily)

**The panel discussion will be presented immediately following the keynote luncheon speaker. This year's subject, "The Future of Self-Contained and Ground Control Navigational Aids," is both timely and challenging and will be moderated by Paul Goldsborough, Captain, USNR, Staff Director for Communications, Office of Secretary of Defense (S&L). Captain Goldsborough will be assisted by a distinguished group of civilian and military experts.

For information write:

SIGNAL
1624 EYE STREET, N.W.
WASHINGTON 6, D. C.

AFCEA Convention Notes

The selection of professional papers to be presented at the 1958 AFCEA Convention has been announced by Rear Admiral Gordon Caswell, Chairman of the Selection Committee. It was most gratifying to note that the response to this year's request for papers far exceeded National Headquarters' expectation. On behalf of the Committee and National Headquarters, Admiral Caswell wishes to express his profound thanks and appreciation for the excellence of all papers submitted for consideration. It was only after hours of evaluation, careful analysis and study that the Committee arrived at the papers which appear on the opposite page.

Under the capable direction of Mrs. Dorothy Christopher, the ladies attending the Convention can look forward to an interesting program. Besides other Convention activities, Mrs. Christopher, as Chairman of the Ladies' Committee, has completed arrangements for the events listed on the opposite page.

Nominating Committee

President F. R. Furth has appointed the following Nominating Committee to name a slate of nominees for the National Board of Directors to fill vacancies which will occur at the end of this year's convention on June 6, 1958: Theodore L. Bartlett, RCA, Camden, N. J.—Chairman; Charles F. Horne, Convair, Pomona, California, and William V. Kahler, Illinois Bell Tel. Co., Chicago.

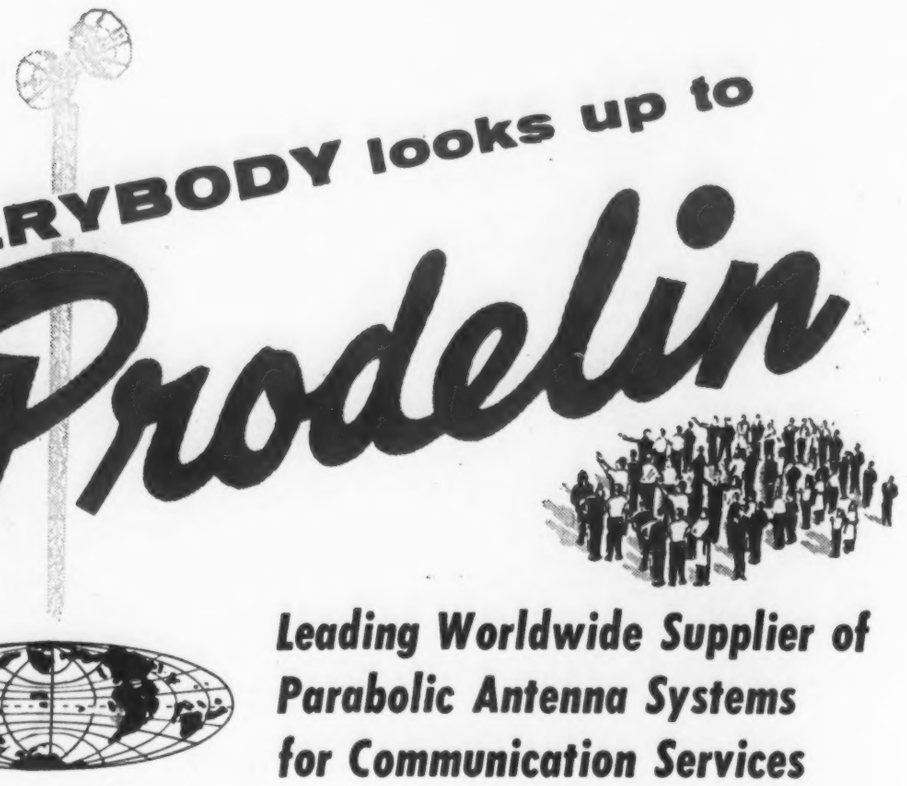
AFCEA New Group Member

AFCEA recently welcomed Trans-Sonics, Inc., Lexington, Mass., as a new group member. The firm is concerned with electromechanical and electronic instruments.

– Members of the firm who will be company representatives in AFCEA are: Vernon C. Westcott, president; Sidney B. Williams, vice president; Robert L. Blanchard, vice president; John Zorzy, project engineer; Arthur E. Sherburne, project engineer; Russell Wolfe, assistant chief engineer; Edward T. Rigney, executive vice president; Alan D. Maier, engineering services manager; Louis O. Mitchell, vice president; Howard A. Morrison, Jr., manager technical sales.

Address Correction

In welcoming the Acme-Danneman Company, Inc. in the March issue of SIGNAL, an incorrect address was given. The correct address is: 45 W. 18th St., N. Y., N. Y.



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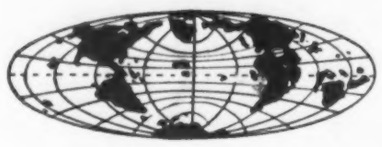


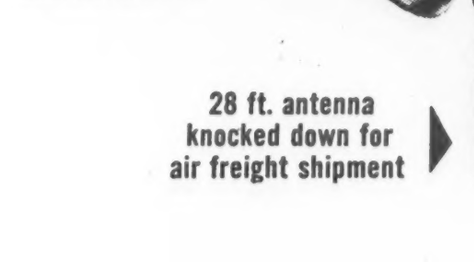
There's much to be gained by using a Prodelin Parabolic Antenna . . . whether your application is for line-of-sight, point-to-point microwave communication, or for over-the-horizon tropospheric scatter service for long distance communications.

Early pioneering experience makes Prodelin the leader that everybody looks up to for quality.

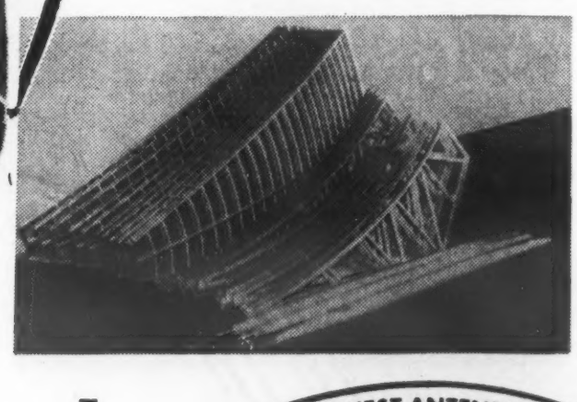
Prodelin manufactures field proved parabolic reflectors with associated feeds providing the most complete antenna line in 2, 4, 6, 8, 10, 14, 18, and 28 foot diameters for every type of communication requirement.

If there is not a stock Prodelin antenna to suit your specific needs, Prodelin will design one for you. In active service throughout the world are rugged Prodelin aluminum mesh antennas that withstand 150 mph windloads fully iced . . . economical spun aluminum reflectors for similar services . . . and the new sectionalized plastic reflectors . . . all designed for low cost, long distance transportation by land, sea, or air. Remember, a Prodelin antenna costs *less* than any other part of your system . . . and with *larger* antennas, you can achieve greater gains at lower maintenance costs!

No wonder everybody looks up to Prodelin . . . it's head-and-shoulders above the crowd.



28 ft. Tropospheric Scatter Antenna



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Dayton-Wright

Maj. Gen. Victor R. Haugen, Asst. Deputy Commander for Weapon Systems, Hdqs. Air Research and Development Command, and Commander of ARDC's Detachment No. 1 at Wright-Patterson Air Force Base, was the principal speaker at the chapter's March 27th meeting. His subject was "Changing Times in Weapon Systems Management." Because of its reader interest, General Haugen's speech will appear in the June issue of SIGNAL.

Gulf Coast

"Tactical Communications" was the subject of the chapter's March 4th meeting. The program was presented at the Keesler Air Force Base Air-Ground Operations School by Maj. L. C. Stansel.

During the business session, Capt. R. Kevin Murray was named to represent the chapter at the annual convention in Washington and to serve as its council representative. It was also decided to hold bi-monthly meetings in the future.

Prior to the meeting, the members and guests met for dinner at Gus Stevens Restaurant in Biloxi.

Hawaii

Kentron Hawaii, Limited, was host to the chapter on March 27th. A tour of the company plant facilities was followed by dinner at "The Willows," courtesy of Kentron.

Kentron is a new firm located in Honolulu which was organized to supply two vitally needed services in the Pacific area: one is the manufacture of cathode ray tubes and specialized electronic products, and the other is to supply technical assistance to the expanding military and industrial users of electronics devices.

Host for the evening was Donald C. Kenney, President of Kentron, who also is chairman of the chapter's National Security Committee.

Kansas City

Principal speaker at the February 27th meeting was Mr. E. S. Kennedy, Chief Engineer of the Telecom Corporation of Kansas City, who presented a program on the "Power Application of Transistors."

Mr. Kennedy covered the technical aspects and characteristics of transistors and demonstrated their applications in the radio and telephone fields. His talk was supplemented by circuit slides and actual transistor models.

Special guest of the chapter was Harold W. Bourell, Engineer of the Federal Communications Commission.

Kansas City—Pictured during the February 27th meeting are, left to right: William R. Wheeler, past president; Harold W. Bourell, FCC guest; Lt. Col. G. D. Meserve, USAF (Ret.), chapter president; E. S. Kennedy, chief engineer, Telecom Corporation, principal speaker, and Col. R. E. Conrath, past president.

Lexington

The General Telephone Company of Kentucky was host to the chapter for a meeting on March 7th. Mr. Sam Long, Vice President of the General Telephone Company of Kentucky, was the speaker of the evening. After welcoming the group, he gave a short history of his company and described plans for local expansion to provide telephone service to meet the rapidly expanding requirements of the community.

A guided tour of the central plant facilities of the company followed. The complex and highly efficient operation of modern dial equipment was explained by the company staff. Chapter members were very favorably impressed by the demonstrated capacity and efficiency of the automatic dial equipment and the individual skills demonstrated by the telephone company employees.

The chapter expressed its appreciation to Mr. Harry Heuther, President of the General Telephone Company of Kentucky, who has been an enthusiastic supporter and member of the Lexington Chapter for many years, and his staff for the very enjoyable program.

The pre-tour dinner-meeting was held at the Lafayette Hotel in Lexington.

Lexington—Chapter officers and guests at the head table at the March 7th meeting, left to right: Merrill Whitmer, treasurer; Rollie Graves, General Telephone Co.; Charles Morrison, president; Lt. Col. Henry L. Morris, Deputy Commanding Officer, Lexington Signal Depot; Harold Madden, secretary; and Sam Long, vice president of General Telephone Co., Kentucky.

Montgomery

Reactivation of this chapter has been initiated by Col. William H. Lyle, Chief, C-E Doctrinal Division, Air Command Staff College, Maxwell Air Force Base.

Lt. Col. Herbert Herman, Hdqrs. Air Command & Staff College, has been designated to act as secretary-treasurer until the formal election of officers.

New York

Mr. Francis Colt deWolf, Chief, Telecommunications Division, United States Department of State, discussed "The Organization and History of the International Telecommunications Union" at the February 26th meeting.

Mr. deWolf's informative talk reviewed the history of the International Telecommunications Union since its formation in 1865. According to Mr. deWolf, ITU was formed in order to promote uniform methods of handling telegraph and radio communications and to resolve such problems as rate structures, regulations of frequencies, agreements and standards for interchangeability of equipment. Mr. deWolf indicated that ITU has no control over telephone communications. It operates on a budget of approximately 1.5 million dollars per year, 8% of which is provided by the United States. The balance is supported by the other 17 countries having membership on the Administrative Council.

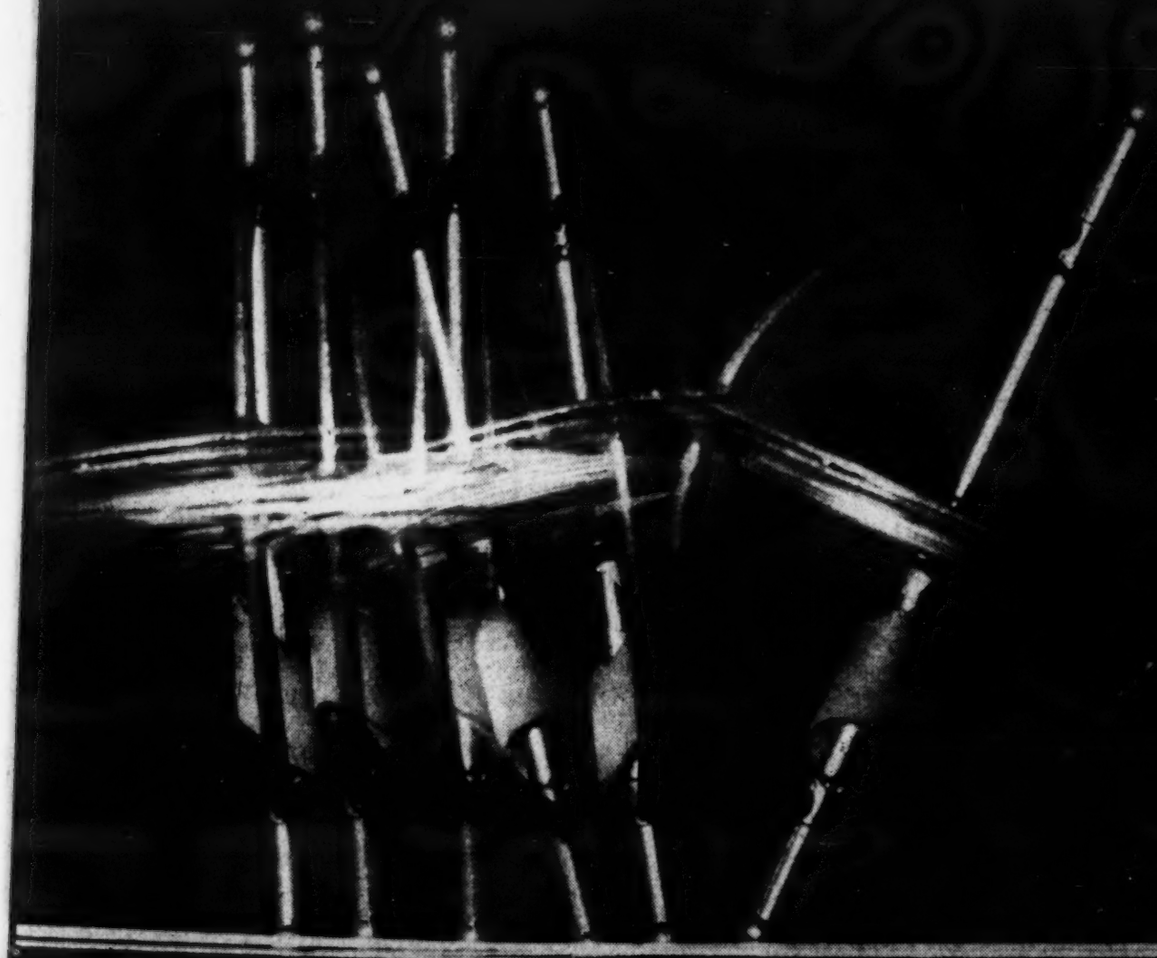
The ITU conducts conferences on telecommunication problems and seeks to resolve these problems through mutual understanding and agreement. These conferences are held in various cities throughout the world and are attended by the ITU and members of the communications industry.

On May 28th, W. W. Watts, Executive Vice President of RCA, will speak on transistors and solid-state devices in military and commercial applications.

New York University

Recent activities of the chapter were: The February 14th meeting featured the Western Electric film "Arctic Mission." This film, produced by the Western Electric Company in cooperation

GYROS



Hoffman Laboratories free directional gyro licensed for manufacture by Humphrey, Inc.

Hoffman Electronics

New York University—A Western Union program on facsimile equipment was featured at the February 28th meeting. Shown, left to right, are: Robert A. Fisch, chapter president; Joel Gross of Western Union, guest speaker; two chapter members and Capt. Kenneth Watson, SigC, chapter advisor.

with the U. S. Air Force, deals with the construction and maintenance of the DEW Line stations.

The February 28th meeting was addressed by Mr. Joel F. Gross of the Western Union Telegraph Company, who spoke on "Principles of Facsimile Transmission." In his talk, Mr. Gross discussed the basic principles of facsimile and how they are applied to the Western Union "Deskfax" system. He also demonstrated the operation of the "Deskfax" transceivers.

Philippine

A meeting was held on February 28th at the Port Officers Open Mess at the Manila Air Station.

Col. Orville Laird, chapter president, introduced 1st Lt. Norman Soucie who is heading a team from Rome Air Force Depot which is currently in the Philippines testing various paths for possible tropospheric scatter type of communications.

With Lt. Soucie were Mr. Edmund E. Pendleton of Westinghouse and Mr. Frederick W. Jones of National Scientific Laboratories. Mr. Pendleton gave a short talk on tropospheric scatter techniques. This was followed by a lively question and answer period in which Lt. Soucie, Mr. Pendleton and Mr. Jones did an excellent job of answering the many questions fired at them.

The chapter reported this was one of the most enlightening and interesting meetings it has ever held.

Pittsburgh

On March 20th, chapter members and their families learned about "The First Man in Space."

Their education on this subject was acquired at the Buehl Planetarium where a special program had been provided for the chapter meeting. The audience participated in a simulated satellite ride with a view of the passing earth, saw rockets blast off, viewed a space station, and had a TV close-up of the moon.

Rome-Utica

The following account of the chapter's March 19th meeting appeared in the Rome *Daily Sentinel:*

"A communications engineer last night indicated that it will be only a matter of time before man travels through space and platforms are fixed in space 26,000 miles from the earth.

"Dr. Thomas T. Goldsmith, Jr., DuMont engineer-executive, told a session of the Rome-Utica Chapter, AFCEA, that these developments will follow the snow-balling accumulation of scientific knowledge that has come with successful launching of American and Russian earth satellites.

"Dr. Goldsmith is a vice president in charge of engineering and research for Allen B. DuMont Laboratories, Inc., Clifton, N. J. Among the 90 persons present at the session in the Griffis AFB Officers Club were educators participating in the local science program sponsored by the Rome Air Development Center and science students of the local area.

"He spoke for more than an hour, using charts, slides, and tape recordings of satellite radio transmissions to illustrate his discussion. These radio transmissions convey information about space condition.

" 'Fixed satellites or space platforms will be used for scientific observation and communication,' said Dr. Goldsmith. He estimated there will probably be three such platforms or fixed installations and these will be in line of sight of one another. 'These platforms,' he said, 'will always stay over the same point in earth, which would turn on its axis 26,000 miles away at exactly their orbital rate.'

"Dr. Goldsmith also outlined some of the controlling conditions for the visual and radio monitoring of the satellites. He said these were the only practical means of keeping tabs on the man-made moons. Each means, he said, has merits of its own. If visibility is good an observer using a visual or optical tracking method need not worry about a dead radio transmitter in the satellite.

"However, a workable transmitter will allow the easy tracking of satellite despite visibility, Dr. Goldsmith said. He pointed out that the radio batteries in Sputnik I lasted about three weeks, but that the batteries used in the Vanguard satellite may have a lifetime of about five years. The possible long life of these batteries is attributed to the use of solar batteries. These make use of the sun's energy.

"He was introduced by Maj. Stanley Wisniewski, program chairman."

San Francisco—Varian Associates were hosts to the chapter at their new plant at Palo Alto on March 20th. During the dinner meeting, above, Emmett G. Cameron, Dr. Russell H. Varian and Dr. Sigurd F. Varian (seated, left to right), applaud the introduction of Maj. Gen. Frank E. Stoner (standing, right) by Chapter President Thomas D. Razovich.

Tinker-Oklahoma City—The chapter's annual research education symposium took place on March 20. Participants in the program, shown above, were, left to right: Harold J. Miller, chief engineer, Southwestern Bell Telephone Co., guest speaker; Lloyd G. Dorsett, president of Dorsett Laboratories and past president of the chapter, who introduced the speakers; Brig. Gen. Phillip C. Wehle, Director of Technical Activities, Artillery and Missile School, Fort Sill, guest speaker, and Chapter President Delbert F. Cravens of Southwestern Bell. Not shown in the photograph was Dr. James G. Harlow, Dean of the College of Education of the University of Oklahoma, the third speaker.

San Francisco

At the March 20th meeting, 150 chapter members and guests were treated to a tour of the new plant of Varian Associates, Palo Alto electronic manufacturer.

The tour was preceded by illustrated speeches by Dr. Russell Varian, Chairman of the Board; Dr. Sigurd Varian, Vice Chairman of the Board; Mr. Emmett Cameron, Vice President and General Manager; Dr. Ted Moreno, Manager of Research and Development, Tube Division; Dr. Martin Packard, Manager, Research and Development, Instrument Division, and Dr. William McBride, Manager of the Radiation Division.

The company is engaged in the manufacture of klystron and other microwave tubes, electron linear accelerators, precision electromagnets and earth's field magnetometers. It is also active in the field of instrumentation and has a competent and successful research organization.

Program arrangements were made by Frank Treadway, the chapter's new meeting and program chairman.

San Juan

At a Board of Directors' meeting on March 5th, the following officer appointments were confirmed: president—James P. Fitzwilliam, Hdqrs. USARFANT; 1st vice president—Frederic Wilhelm. RCA Communications, Inc.; 2nd vice president—Kenneth M. Barbier, Radio Corporation of Puerto Rico; additional directors: Thomas Ramirez and Capt. James Hollis, Antilles Signal Office; Ralph Quainton, Naval Communications Station, San Juan, and Jack Diamond, Puerto Rico Telephone Company.

The regular monthly meeting on March 20th constituted a general get-together of members and guests for dinner and a general discussion of AFCEA matters.

Guests were introduced as follows: Col. Merle C. Bowsky, Signal Officer, USA-Caribbean; Col. Dulaney O'Rourke, Commanding Officer, Losey Field, P. R.; Lt. Col. E. C. Radigan, Signal Corps Project Officer for the new Losey Communications Station, member Washington Chapter, AFCEA; Capt. D. D. McGrew, OCSigO, Washington; Capt. Whitfield, C. O., U. S. Naval Communications Station, San Juan; Mr. Clyde Dickey, President, Puerto Rico Telephone Co.; Mr. R. McCall, All America Cables & Radio, Inc.; Mr. Sam Kleig, Caribe Textiles, Inc.; Mr. J. R. Vidal, science student at University of Puerto Rico, and Mr. Pedro Sanchez of Linmar Electronics, Inc.

Brief talks were given by: Mr. Dickey, who discussed improvement in telephone service throughout Puerto Rico; Colonels Radigan and O'Rourke, who reported on the Army's new projected communications station at Camp Losey, near Ponce, P. R.; Capt. Whitfield, who complimented the chapter on its activities and, particularly, on its program of assistance to the Commonwealth Vocational School, and Col. Bowsky who gave a brief account of Signal Corps activities in general in the Caribbean area.

Scott-St. Louis

"The Strange Case of the Cosmic Ray," one of the Bell System's series of science color films, was the program feature of the March 7th dinner-meeting.

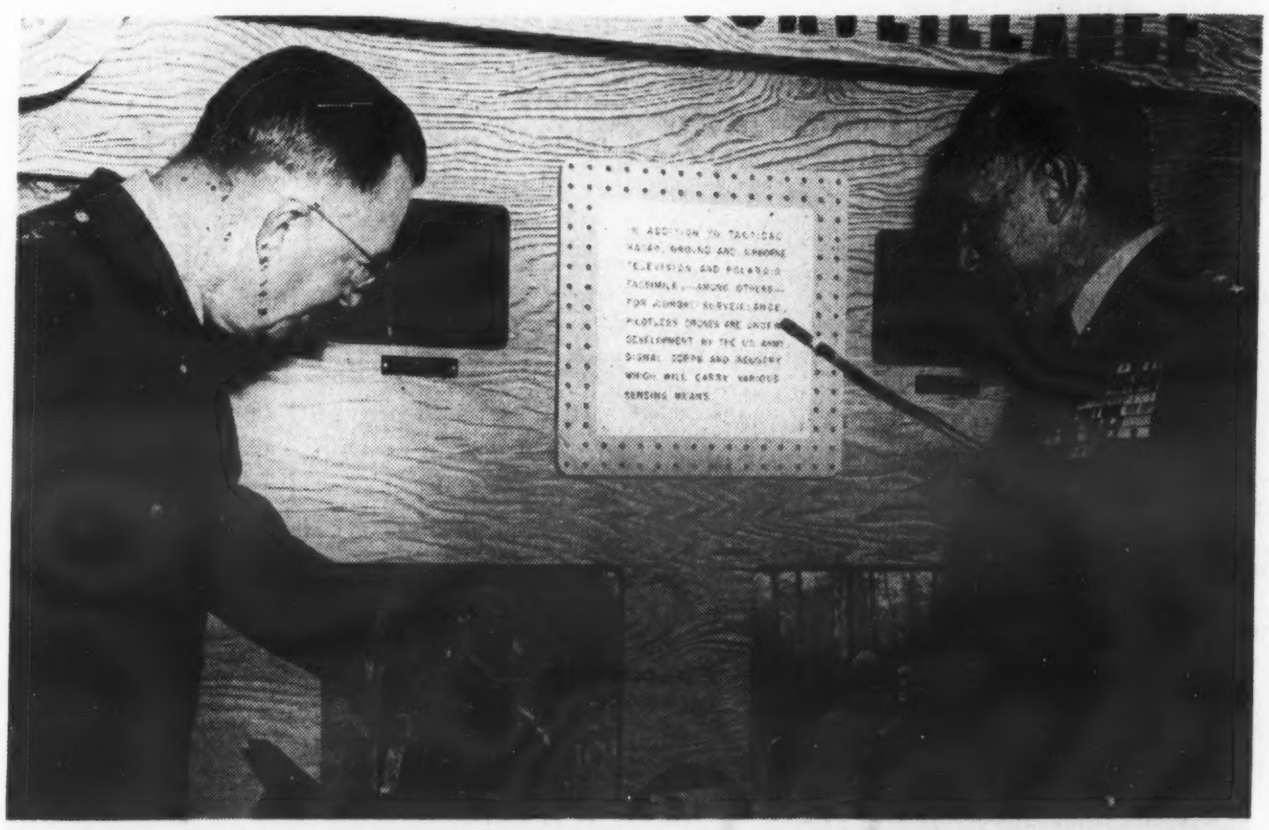
An introduction to the program was presented by Chapter President Roger Robards, Southwestern Bell Telephone Company.

Tinker-Oklahoma City

The chapter's annual Research Education Symposium was held on March 20th at the Student Union Building of the University of Oklahoma. The speakers and their subjects were: Brig. Gen. Phillip C. Wehle, Director of Technical Activities, Artillery and Missile School, Fort Sill, Okla.—"The Army's Missiles and Their Meaning;" Dean James G. Harlow, Dean of the College of Education, University of Oklahoma, and Director of the Frontiers of Science Foundation—"The Ordeal Facing Future Education;" Mr. Harold J. Miller, Chief Engineer, Southwestern Bell Telephone Company, Okla.—"Electronics In and Out of This World."

The some one-hundred members and guests present included university professors and electronic engineers in the military and industrial fields. In addition, as special guests of the chapter were seven outstanding Oklahoma City senior high-school students who had excelled either in mathematics or science courses during their high-school careers.

(*Continued on page* 64)



Washington—Maj. Gen. James D. O'Connell, Chief Signal Officer, U. S. Army, points out a Signal Corps exhibit to Lt. Gen. Arthur G. Trudeau, new Chief of Research and Development, U. S. Army, at the April 1st luncheon-meeting of the chapter. General Trudeau addressed the meeting on the subject of "Army Research and Development in Communications and Electronics."

NEW PRODUCTS FROM INDUSTRY

Most Accurate U.S. Radar Indicator

Increased accuracy and speed in weather forecasting is the promise of a new meteorological radar indicator developed by Allen B. DuMont Labs., Inc., of Clifton, New Jersey. Claimed the most accurate radar indicator system developed in the U. S., the instrument has a tested azimuth accuracy of ± .25 degrees.

Developed for use under contract with the Raytheon Manufacturing Co., the indicator system will have military and commercial applications in addition to its meteorological use.

Ready for quantity manufacture, the indicator supplies long-distance information on weather conditions and is used in conjunction with a complete meteorological radar system to display highly accurate data on the range, azimuth, and height of storm areas, cloud formations, and other significant air masses. Moreover, the unit enables weather scientists to analyze the vertical structure of storm formations.

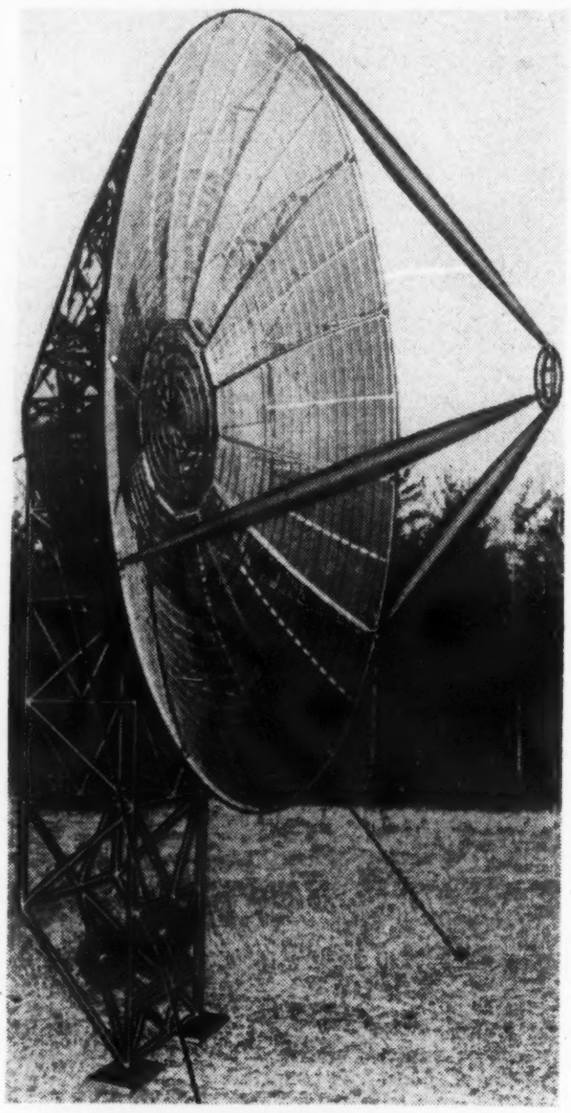
"Space Speedometer"

Sperry Gyroscope Co. of Great Neck, N.Y., has developed a new 3-dimensional "space speedometer"—a 1½ pound, ultra-sensitive "accelerometer"—which is the companion instrument with gyroscopes to feed signals to a miniature computer for jam-proof inertial guidance systems, where immunity to enemy detection or interference is desired.

When teamed with gyros on various axes, the new accelerometers microscopically detect and measure exact velocity in any direction of spherical space. Company scientists report the device is "capable of detecting the slight gravity force produced by an angular deflection as small as one 10,000th of a single 1-minute space on a wrist watch."

Design of the instrument provides a rugged sensing mechanism moving minutely in a precise straight line—a radical departure from the pendulous type. Accuracy of the device is claimed to be "within hundredths of one percent."

The "space speedometer" is most suitable for winged missiles and aircraft flying either in the high supersonic or the low hypersonic range, and for long undersea voyages deprived of star-sight corrections or radio aids.



Erected, Kennedy's mobile antenna stands 24 ft. from ground to radiation center.

Large Mobile Antenna

D. S. Kennedy & Co. of Cohasset, Mass, has developed a new mobile antenna having a 28-foot diameter reflector which is constructed of welded aluminum and sectionalized to enable it to be stored within its mounting tower. Retractable wheels convert the structure into a trailer.

The mobile feature of this antenna makes it particularly adaptable to scatter site survey work and its compact construction allows economy in shipping costs since, for example, the structure can be rolled aboard a transport plane and secured without additional crating.

Designated Model 749, the antenna is designed for use at frequencies between 200 and 4000 mc.

Battery Operates at −100° F

A primary battery called the "Arctic," featuring ability to operate over a range of temperatures from 180° F down to −100° F and offering an unusually high terminal potential approximating 2.55 volts at −100° F, has been developed by Yardney Electric Corp. of New York.

The non-aqueous Arctic cell employs calcium for the negative plate, silver chloride for the positive plate, and an electrolyte with an acetonitrile solvent. It provides 5 watt-hours at −100° F and 18 watt-hours per pound at room temperature (75° F).

It is expected that the Arctic will find application in radio equipment and other devices used in low temperature regions, including use at high altitudes.

High-Speed 'Space' Camera

The Wollensak Optical Co. of New York has developed a high-speed motion picture camera, the "Fastair," which operates up to 16,000 frames per second and which is said to meet specific design requirements as to provide picture of superior quality when mounted in test missiles or vehicles accelerating to extremely high rates of speed.

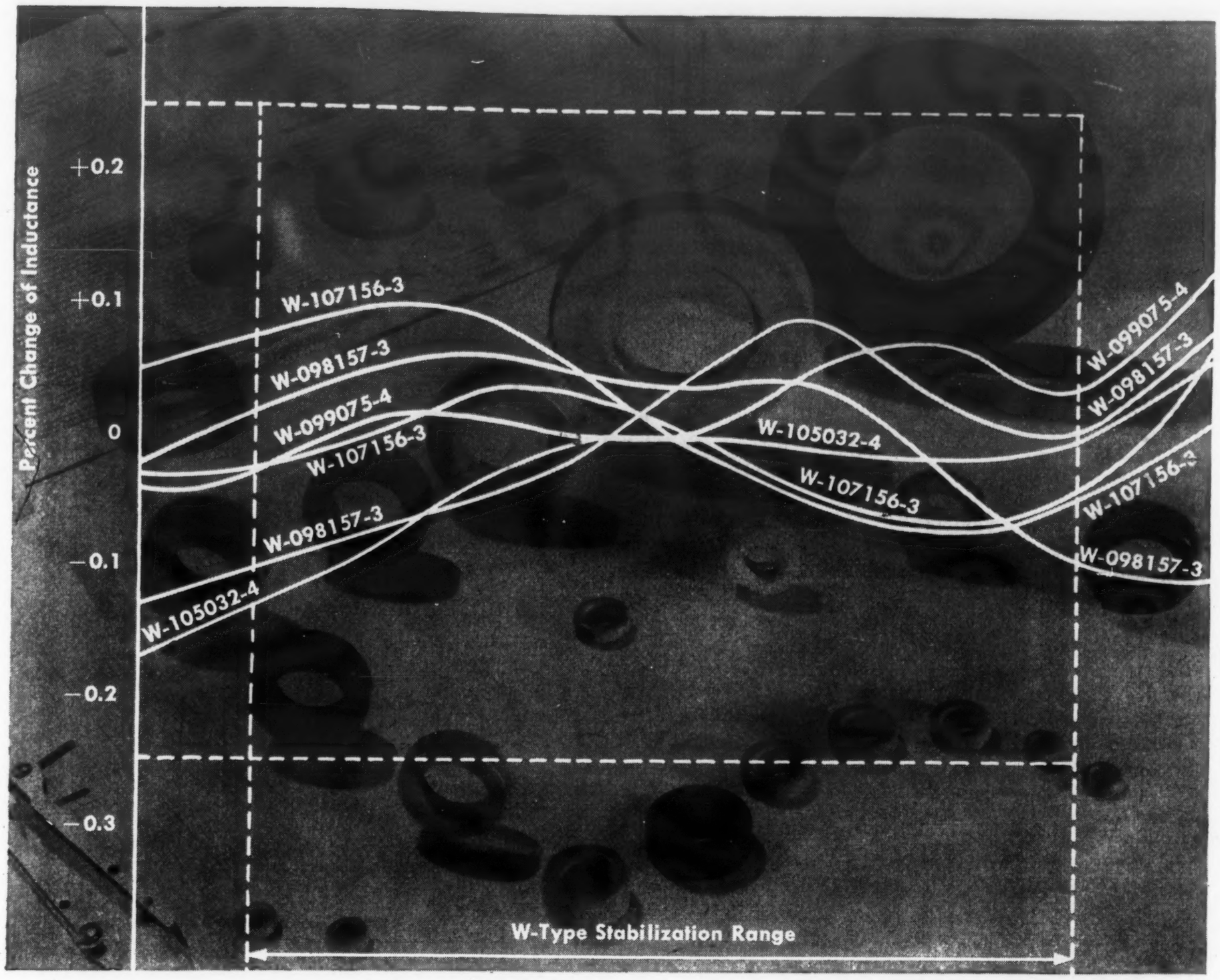
Specially engineered to record the flight characteristics of guided missiles and their components, the camera fulfills these specifications: operation when subjected to "G" loads in acceleration or deceleration up to 100 times the force of gravity at almost any attitude; compact in size and weight; contains a timing light, timing light pulse generator, thermostatically controlled heaters, a wide variety of interchangeable lenses, and a flat-speed characteristic curve; stop-start operation; accepts standard daylight leading film spools.

In the Fastair, there is a special rotating prism, synchronized with a drive sprocket continuously moving film through the camera. Since there is no stationary cycle, the Fastair shuttering method permits extremely short exposure times and subsequent excellent "action-stopping" ability.

High Quality Tape Recorder

A professional tape recorder, the Presto "800," is said to offer benefits of higher efficiency, wider flexibility, greater operating ease and the finest recording quality by its manufacturer, Presto Recording Corp., of Paramus, N.J., a subsidiary of The Siegler Corp.

Providing the needs of radio stations, studios, phonograph record manufacturers and industrial users, the "800" recorder features 3 motors, a 10½ reel capacity and solenoid-



ARNOLD offers you the widest selection of Temperature Stabilized MO-PERMALLOY POWDER CORES

Arnold Molybdenum Permalloy powder cores are available with the temperature coefficient of inductance controlled within certain limits over specific temperature ranges. Most core sizes and permeability combinations can be supplied in at least one of the four different types of temperature stabilization available.

For example, most of the popular core sizes are manufactured in the new type of wide range—"W"—stabilized cores whose temperature coefficient of inductance does not exceed 0.5% over the temperature range covered by the MIL-T-27 specification of −55° C to +85° C.

This type of guaranteed maximum change of inductance with temperature, as well as the constancy of permeability with time and flux level, are of particular importance to apparatus and circuit engineers. Many precision military and industrial applications demand the uniform performance and the excellent physical properties found only in Arnold Mo-Permalloy powder cores.

For design flexibility they are furnished in a full range of sizes, up to 5.218" O.D., in four standard permeabilities: 125, 60, 26 and 14. You will find them dependable and easy to use. You will find most sizes and types in stock *now* for immediate shipment.

● Let us furnish your requirements for temperature stabilized Mo-Permalloy powder cores, or any magnetic materials you need, from the most complete line in the industry.

WSW 6999

For more information write for Bulletin PC-104B

Lists complete line of Mo-Permalloy Powder cores . . . available in 25 sizes from 0.260" O.D. to 5.218" O.D. Furnished also with various types of temperature stability from Type "A" unstabilized to Type "W" stabilized over the temperature range of −65° F to +185° F.

ADDRESS DEPT. S-85

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois

Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

District Sales Offices:

Boston: 49 Waltham St., Lexington Los Angeles: 3450 Wilshire Blvd.

New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

NEW PRODUCTS

operated brakes of a new design which eliminates frequent readjustment. Interlocked push-button relay controls are individually, functionally illuminated. Other outstanding features are also included in both unmounted and stereo console models.

Fastest Industrial X-Ray Film

Kodak Industrial X-Ray Film, Type KK, a new type film recently announced by Eastman Kodak Co. of Rochester, N. Y., has an approximate 50% speed increase over the fastest Kodak industrial X-ray film now available, and is expected to prove particularly valuable in reducing exposure time in radiographic inspection of thick sections, such as marine propellers of large steel castings.

In examination for gross defects, it is claimed that tests have indicated the new film's radiographic sensitivity compares favorably with Type K Film, now being replaced by this new Type KK. The new film will be available in the same size listings and at the same prices as the previous type.

Miniature TV Camera

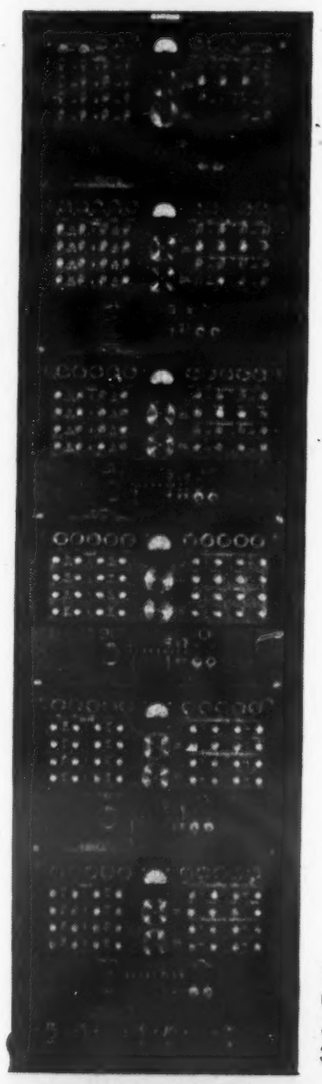
"The world's smallest and first fully-transistorized, automatic TV camera" has been developed by the Dage TV Division of Thompson Products, Inc., Michigan City, Indiana.

All the technical features of broadcast equipment are included in the miniature camera; yet it weighs about 4 pounds and measures slightly more than a paper-back book. The unique dimensions were made possible by replacing all tubes with transistors and all wires with printed circuits. Each series of plug-in, printed-wiring strips represents a particular function of the camera system.

The camera's 6 basic modules are the video amplifier, sweep amplifiers, synchronizing generator, binary strip, power supply and oscillator strip. Operation is possible on almost any adjacent power.

Since all controls have been removed from the camera and the video signal may be transmitted up to 2,000 feet without a line amplifier, remote operation is possible.

Coupled with the camera's size and weight features, its electronic and automatic light level compensator makes the system highly useful for airborne use.



MINIATURIZED CARRIER TELEPHONE SYSTEMS FOR RADIO AND 4-WIRE CABLE

FOUR OR 24 CHANNELS

Two miniaturized voice-multiplex systems providing four or 24 voice channels over radio or 4-wire cable are available. They have many advantages over earlier designs: high performance, small size, light weight, low cost, circuit simplicity, low power requirements, small number of tubes of a single type only, low operating cost, low maintenance and high reliability.

These systems provide a voice-channel flat within 1 db from 300 to 3500 cycles, for each 4 kc of bandwidth occupied. Each channel is equipped with hybrid, signalling, and dialling circuits for all the standard 2-wire and 4-wire loop options.

The basic unit provides an order-wire and 4 carrier-derived channels. These units can be stacked in groups of 2, 3, 4 or 5 by means of a group modem to provide 9, 14, 19 or 24 channels. Full flexibility is provided for dropping and inserting channel groups at repeater and terminal points. Moderate lengths of 4-wire cable or open-wire line may be inserted between the multiplex equipment and the radio terminals.

24-channel carrier-telephone terminal complete with hybrids, ringing and dialling circuits, and test facilities. Dimensions are 58" high, 16" wide and 8" deep. Power input 250 watts. Weight 326 lbs.

RADIO ENGINEERING PRODUCTS
1080 UNIVERSITY ST., MONTREAL 3, CANADA
TELEPHONE UNiversity 6-6887
CABLES RADENPRO, MONTREAL

New Literature

Directory of R & D Labs

Recently issued by the National Science Foundation, the publication "Directory of Independent Commercial Laboratories Performing Research and Development, 1957" may be obtained for 40c from the Superintendent of Documents. Government Printing Office, Washington 25, D. C.

The directory lists 565 labs along with names of senior officers, numbers of research staff, and types of research activities.

Soviet Progress vs. American Enterprise

Recently released by the Committee for Economic Development (CED) were the documented opinions of five experts stating a comparison of the United States to Russia in the areas of missile propulsion, technical education, various fields of research, weapons system decision-making processes, aspects of military readiness and additional subjects of timely importance.

The papers, originally submitted as confidential briefs to CED, are now available at $2.00 a copy from Doubleday & Co., Inc., New York, under the title "Soviet Progress Versus American Enterprise."

Authors of the opinions are Presidential Adviser Clarence B. Randall; Edward L. Allen, Director of Economic Research for the Central Intelligence Agency; Prof. J. Sterling Livingston of the Harvard Business School; Prof. Jerome Wiesner of M. I. T., and Prof. Warren W. Eason of Princeton University. Included in the publication is an address by Vice President Richard M. Nixon and one by William C. Foster, co-chairman of the "Gaither" Committee.

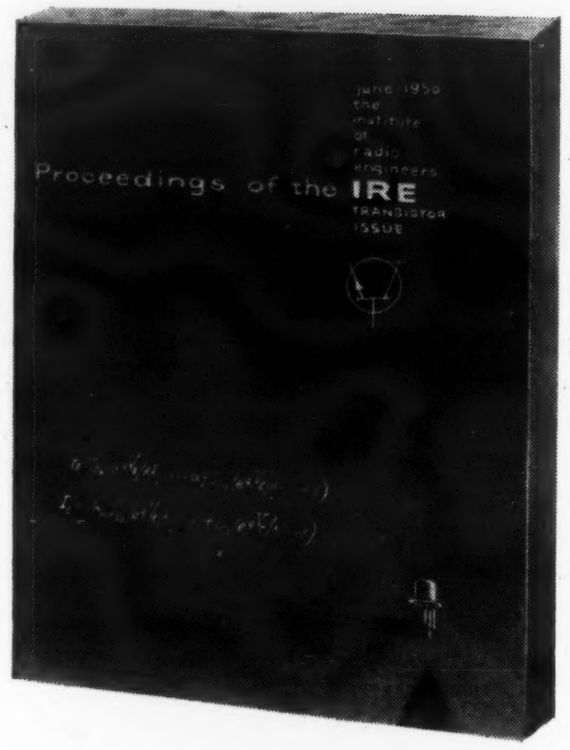
Index to Scientific Journals

To include SIGNAL Magazine, a new publication indexing by subject and author 510 scientific periodicals will be offered later this year by Micro-Photography Co., 97 Oliver St., Boston 10, Mass.

The indexes, compiled by the Library of the U. S. Naval Research Laboratory, will comprise several hundred thousand entries and will cover these primary subjects: solid-state physics, nucleonics, radiation, optics, mechanics, astrophysics, radio, electronics, sound, astronomy, rockets, guided missiles, artificial satellites and space travel.

The publication will be available only to those who subscribe in advance of printing, to start the 3rd quarter of this year.

THE DECADE OF THE TRANSISTOR



IRE commemorates the tenth anniversary of a major breakthrough in solid state electronics by devoting the entire June issue of PROCEEDINGS OF THE IRE to an up-to-date summary of progress and advances in transistors. So small that many can be held in the palm of one hand, these tiny components have ended our 50 year dependence on vacuum tubes. Without transistors, our intricate guidance and communication systems for missiles would be incredibly big and heavy. With them, whole new technologies are being developed, not only for defense but for industry and commerce as well.

June Issue of Proceedings of the IRE is the New Standard Reference Work on Transistors

Only once before has PROCEEDINGS devoted an entire issue to transistors. That was in November, 1952. Despite a substantial overprinting, every copy was sold within 3 months. This classic issue, coming at a time when there were no books and few papers on the subject, is still considered one of the basic references on the subject...a suitable companion to the definitive Solid-State Electronic issue of December, 1955 and the Ferrites issue of October, 1956.

Now, to mark the tenth anniversary of the transistor, PROCEEDINGS presents the latest advances in theory and application in the June, 1958 issue. Here you will find introductory articles by its inventors—Shockley, Bardeen and Brattain—specially invited papers reviewing progress in all facets of the subject, contributed papers reporting the latest and more important advances in the field. Be sure to order your copy, today!

Partial Contents:

"The Technological Impact of Transistors," by J. A. Morton & W. J. Pietenpol, Bell Labs.
"The Status of Transistor Research in Compound Semiconductors," by D. A. Jenny, RCA.
"Survey of Other Semiconductor Devices," by S. J. Angello, Westinghouse.
"Electrons, Holes and Traps," by W. Shockley, Shockley Semiconductor Lab.
"Recombination in Semiconductors," by G. Bemski, Bell Labs.
"Noise in Junction Transistors," by A. van der Ziel, University of Minnesota.
"Formation of Junction Structures by Solid State Diffusion," by F. M. Smits, Bell Labs.
"Germanium and Silicon Rectifiers," by H. Henkels, Westinghouse.
"The Potential of Semiconductor Diodes in High-Frequency Communications," by A. Uhlir, Bell Labs.
"Advances in the Understandings of the P-N Junction Triode," by R. L. Pritchard, Texas Instruments.
"Power Transistors," by M. A. Clark, Pacific Semiconductors.
"Application of Transistors in Computers," by R. A. Henle & J. L. Walsh, IBM.
"Application of Transistors in Communication Equipment," by D. D. Holmes, RCA.
"Characteristics Data on Silicon and Germanium," by E. Conwell, Sylvania.

The Institute of Radio Engineers
1 East 79th St., New York 21, N. Y.

◯ Enclosed is $3.00

◯ Enclosed is company purchase order for the June 1958 issue on Transistors.

Send this special issue of **Proceedings of the IRE** to:

NAME_____

COMPANY_____

ADDRESS_____

CITY & STATE_____

All IRE members will receive this June issue as usual.

Extra copies to members, $1.25 each (only one to a member).

ITEMS OF INTEREST
From Government, Industry and the Services

AFCEA's New San Diego Chapter

On April 9, AFCEA's newly formed San Diego Chapter held its first meeting at the San Diego Civil Defense Hdqrs., Gillespie Airport, Santee, California. Under the direction of Cmdr. Samuel Freedman USNR (Ret.), acting chairman, regular chapter officers were elected and important organizational details were settled.

Entertainment featured the presentation of a recent British film on the H-bomb, followed by a description and inspection of the radiological and communication facilities of the San Diego Civil Defense Organization.

RAdm. Paul W. Hord, Cmdr. Freedman and Cmdr. Ray Meyers are the Southern Californians whose vision and enterprise are largely responsible for the initiation of this new chapter which bids to be a large, vigorous and prosperous one. The June issue of SIGNAL will cover further details on this chapter.

AFCEA "HAM NET" GROWS

Listed below is an additional listing of Ham Amateur Operators' Call Letters which has been received since the previous publications of the Call Letters in the January and March issues of SIGNAL magazine.

ARIZONA: K7BQL, W7ZOC, KNSLCE, W7BC, W7KOL

CALIFORNIA: W3QR/6, W6AJU, W3CZC, W3HJT, W3IHK, W3KW, W3MLZ, W3ONP, W3OON, W3ORS, W3STD, W3TMY, W3UJI, W3YY, W6NIV, K6AB, K6FH, K6PZS, K6UOM

CONNECTICUT: W1BUD

DISTRICT OF COLUMBIA: K6-AB

GEORGIA: W4AAY

KANSAS: WØMEF

KENTUCKY: W4DK

MARYLAND: W3DWC

MICHIGAN: W8MGQ

NEW JERSEY: K2FV, W2GVU, W2NUI, W2VZG

NEW YORK: K2ASQ, W2BR, W2LUO, W2TIM

OHIO: W8QBF

PENNSYLVANIA: W3QR, W3V-HV, W3RFJ, W3OWU & A3OWU

SOUTH CAROLINA: W4TRI

VIRGINIA: W4ADZ, W4IH, W4-KMN, W4KN, W4LW, W4WVS

HAWAII: KH6BB

PUERTO RICO: KP4AB

Value Engineering Seminars

The Industrial Education Institute of Boston, Mass., in cooperation with industrial organizations and government activities, will present a series of one-day seminars in major cities throughout the country, presenting the concept and basic principles of Value Engineering, a new cost-reducing technique.

The seminars will give industry a demonstration of the application of these new techniques, with special emphasis on the benefits and substantial dollar savings that can be made by companies of every size. Examples of how Value Engineering programs are organized, how the method functions and how to lay the groundwork for acceptance of Value Engineering within a company will be detailed.

Instructors include the three men who created and developed these Value Engineering methods and procedures: Albert Sikorsky, Bureau of Ships, USN; Jack Scheineman, Advisor to Small Business Administration, and Bernard Eades, Chief Value Engineer, Stromberg-Carlson Co.

Site for Observatory

A site 40 miles southwest of Tucson, Arizona, has been chosen for the new National Astronomical Observatory: Selected after a three-year study by a team of astronomers, Kitt Peak, in the Quinlan Mountains, was approved recently by the National Science Foundation.

The area is at an elevation of 6,875 feet and has a flat area of 70 acres on the summit. It is located on the Papago Indians' reservation and although Kitt Peak is sacred to the Indians, the District and Tribal Councils have indicated their willingness to have the ground used for scientific purposes.

The site was recommended to the Foundation by its contractor, the Association of Universities for Research in Astronomy, Inc.

Edge of Universe

Man may be able to see to the edge of the universe due to the development of a maser-telescope. The disclosure was made recently by Dr. Charles H. Townes, Columbia University professor of physics.

The device uses as the maser amplifier a synthetic ruby which was developed by Columbia and the U. S. Naval Research Laboratory. It is expected to result in radio telescopes giving as much as 100 times the sensitivity of currently used electronic types.

The ruby heart of the telescope receives radio signals from planets or galaxies of outer space at the extremely high frequency of 9000 megacycles.

The gem emits some of its own internal energy at the same frequency when struck by these signals, thus greatly amplifying the tiny signals.

The telescopes in use now have ranges up to approximately two-billion light years. Reports from experts indicated that a range of only a few times farther would allow sight of the edge of the universe.

Dr. Townes declared, "It is hoped that the improved range of radio- telescopes afforded by the new maser techniques will allow a look toward the edge of space, quite possibly indicating whether present ideas of an expanding universe are correct, as well as providing a means of checking other cosmological theories."

Russian Translation

The United States Air Force reports that for over two years active measures have been taken to bring U. S. engineers up to date on the Russian scientific progress. Research and development engineers have been working on a machine that will automatically translate scientific Russian into English.

Said to be near completion, the device has a Russian-English "dictionary" capable of translating 160,000 Russian entries. The machine was described by George Shiner, a U.S.A.F. electronic engineer at Rome Air Development Center, New York, during the 46th Annual IRE Convention.

The "dictionary," or "brain," is on a glass disc, 10 inches in diameter, which rotates at 1200 rpm. The Russian words and their English meanings are photographically coded on the glass disc in black marks. Capacity of the disc is 60-million marks—6 million per square inch. Passage by an electronic "eye" translates the marks into electrical signals that are interpreted and translated by an electronic computer.

The technical breakthrough for this development occured several months ago when the photoscopic memory machine, designed and developed by Dr. Gilbert W. King, International Telemeter Corp., was experimentally demonstrated.

U.S.-Russian Exchange

An agreement signed recently by the U. S. and Russia has as its intent the exchange of scientists and engineers.

Within the next two years, scientists and engineers from the two countries will be touring each other's countries, delivering lectures and holding seminars. Joint studies, probably only in the basic sciences, will be conducted by some of the participants.

Both countries have agreed to promote the exchange of publications in science and technology between scientific institutions and societies. Individuals are invited to participate.

Folding "Jeep"

A folding "jeep," which can be parachuted from an aircraft, has been designed by a British firm. Successful and extensive trials were carried out on the prototype of a 700 lb. four-seater jeep-type vehicle.

The craft, developed by Hunting Percival Aircraft, Ltd., can be converted into a neat, 9-foot-long box.

According to reports, use of materials such as light alloys and aircraft construction techniques combines lightness and compactness needed for air transport with the strength and roominess required for ground operational use.

Called the "Harrier," the "jeep" is less than one quarter of the weight of the standard quarter-ton truck and occupies, when folded, less than one tenth the hold space. The Harriers also can be stacked on one another without the need for supporting racking.

The vehicle is an open four-seater car powered by a 650 cc BSA twin cylinder rear-mounted engine.

Maximum speed is slightly more than 60 m.p.h. The present bottom gear give 4 m.p.h. per 1000 r.p.m. of the engine.

Reserve Award

The Bell Telephone Company of Pennsylvania and The Diamond State Telephone Company recently received The Department of Defense Reserve Award in recognition "of outstanding cooperation in their policies toward military reservists and reserve activities."

In a ceremony which was held at companies' Philadelphia headquarters, telephone company President W. D. Gillen accepted a certificate of award from Rear Admiral E. R. McLean, Jr., USN, Commandant of the Fourth Naval District.

The Reserve Award was established in 1955 to honor business firms whose personnel policies encourage reserve participation and publicize reserve activities in company publications, exhibits and advertising.

Inside the Heart

A new development in medical electronics has made it possible to take blood samples from within a beating heart and simultaneously make extremely accurate measurements of in-heart blood pressure.

The tiny pressure pickup device threaded through arteries directly into the heart will help diagnose various heart defects.

The instrument, thinner than a match stick and only half an inch long, was developed in cooperation with the Henry Ford Hospital by the electronics department of the scientific laboratory of Ford Motor Company.

The system measures blood pressure actually inside the heart and because of this is free from interference and distortions. Blood pressure is converted into electrical signals so small that the electronics laboratory had to develop a new amplifier to bring the electrical pulses up to a level that could be recorded.

Satisfactory results were obtained in animal experimentation and the instrument now has been used on more than a dozen adult patients.

The type of diagnostic research being done is called "cardiac catheterization," and involves studies of blood pressure and pulse in the heart, plus a sampling of blood taken from one of the chambers.

The sensing element employs the strain-gage principle and within the device a miniature bellows is activated by cardiac pressure. The bellows presses against a coil of wire (many times thinner than a human hair) that encircles it. This wire has a current of electricity running through it and when stretched by the bellows it increases its electrical resistance.

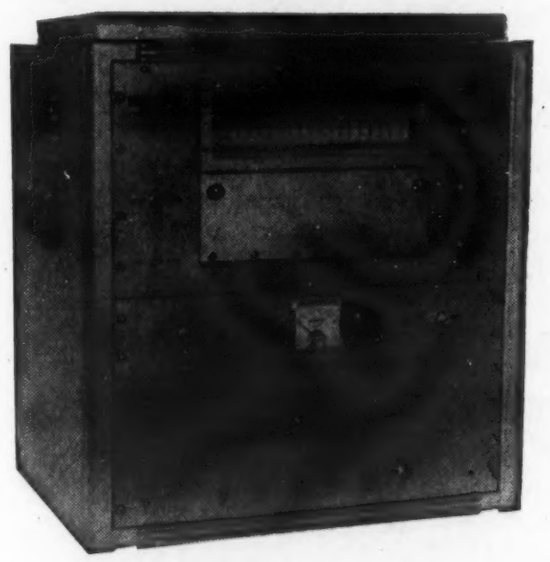
This electrical change, amplified and recorded, has a higher natural frequency than other types, above 2000 cycles per second. Because of this, its readings are particularly valuable for work with infants and children where faster heartbeats increase the problem of interference by vibration.

NEW

improved

RECTANGULAR RECORDER

For Antenna Pattern Measurements Featuring New Plug-In Potentiometers



PEN SYSTEM

- writing speed: 40 inches per second (maximum);
- response: choice of linear, logarithmic and square-root or any combination;
- accuracy for linear response: ±0.3% of full scale over entire range;
- accuracy for logarithmic response: ±0.2 db over entire range of 40 db;*
- accuracy for square-root response: ±0.5% of full scale over first 20 db, ±1% over next 20 db range;*
- sensitivity: 1, 10 and 500 microvolts give full scale deflection for linear, square-root and logarithmic responses respectively.

* The accuracy and dynamic range of the recorder refer to the input of a square-law detector. The recorder actually has a dynamic range of 80 db.

CHART SYSTEM

- speed: 12 inches per second (maximum);
- scales: 0.5, 3 and 18 degrees of antenna rotation per inch of chart travel;
- chart accuracy: 0.02 inch static and 0.06 inch at chart speed of 4 inches per second.

PRICES:

The Series 121 Rectangular Recorders are available in the following models:

Model 121-A Logarithmic $4,300
Model 121-A-1 Linear-Logarithmic . 4,800
Model 121-A-2 Linear-Square Root . 4,800
Model 121-A-3 Linear-Logarithmic-Square Root 5,600

SCIENTIFIC-ATLANTA, INC.

2162 Piedmont Road, N.E.
Atlanta 9, Georgia

Electricity From Sun

Working in conjunction with the U. S. Army Signal Laboratories at Fort Monmouth, New Jersey, the Semiconductor Division of Hoffman Electronics Corporation has developed and built the world's first solar energy cells to power a space vehicle's radio transmitting system.

The firm thus helped provide the Navy's successful Vanguard satellite with a radio transmitter power source, which converts the sun's energy directly into electricity without batteries of any kind.

The solar cells are wafer-thin discs of highly purified silicon diffused with tiny quantities of arsenic and boron. Installed in a special "solar convertor" mounting on the space vehicle's surface skin, the solar cells trap light energy from the sun and convert it into electricity to operate one of the Vanguard's two radio transmitters.

This solar cell electrical system has a minimum life of 300 years under space conditions, according to M. E. Paradise, Executive Vice President of the Hoffman Division. Previously launched satellities from both the U. S. and the Soviet Union have been able to transmit radio signals to earth for only a few weeks at most because of the short-lived, standard storage battery systems used.

In the area where the Vanguard travels, sunlight contains roughly 1400 watts of electrical power per square yard of solar cell collecting area. Thus, a one-yard square Hoffman solar converter produces 140 watts of power, according to reports.

Tube Reliability

With emphasis on those intended for missile, rockets and space craft, a device to increase the standards of reliability in electronic tubes has been developed by General Electric.

One of the current, most difficult problems involves mass-producing high reliability tubes that will withstand the severe vibration encountered in missiles and rockets. GE has a machine which can instantly test production-line miniature and subminiature tubes for vibrational characteristics over a wide range of frequencies.

It is believed that the speed at which the "impulse tester" can be operated makes it practical for use as a standard test to insure that tubes coming off the production line will perform satisfactorily under the difficult vibrational environment of space vehicles.

In the machine, a pendulum-type tapper strikes the glass envelope of a tube which is operating without signal voltage. Both peak and integrated values of any plate voltage variations thus produced in the form of a decaying wave train are measured with meters which hold their readings until reset. For design studies, the wave train can be recorded on a special oscilloscope to determine any major resonant frequencies of the tube under test. Vibration tests currently in use are (1) the much slower swept-frequency method and (2) the random-vibration test which is applied only to subminiature tubes.

"Significant Breakthrough"

Major reduction in the size and complexity of computers, remote control equipment and other large electronic systems may be the result of a "significant breakthrough" announced by RCA Laboratories.

"A long, forward step has now been taken with an experimental shift register transistor under development by Dr. J. T. Wallmark of the RCA Laboratories technical staff at the David Sarnoff Research Center," Dr. Irving Wolff, Vice President, Research, said in making the disclosure.

The advance has been achieved in research aimed at developing a new class of ultra-miniature "integrated" electronic devices that will combine many different functions in a few small components, according to Dr. Wolff.

Names in the News

Maj. Gen. Dudley D. Hale has been named Manager of the Washington office of the Martin Co. He commanded the Airways & Air Communications Service of the US Air Force until January of this year and during his 30-year military career held a number of important communications assignments.

Lt. Gen. Arthur Gilbert Trudeau has succeeded **Lt. Gen. James M. Gavin** as Chief, Research and Development, Office of the Chief of Staff. Before his present assignment, Gen. Trudeau was named Commanding General, I Corps, US Army Forces, Far East Command.

Carroll M. White will become Executive Secretary of the Special Industrial Radio Service Association July 1. He will assume the post as soon as he relinquishes his position as Mobile Radio Communication Manager for the Electronic Industries Association.

Lt. Colonel Louis H. Wilson, (USAF, Ret.) has been named to head the newly activated Colorado Springs, Colo., office of RCA Defense Electronic Products. Formerly Chief of the Radio-Navigational Aid Branch, Headquarters, Strategic Air Command, Col. Wilson has had 28 years' experience in military air communications.

Major General Harold W. Grant will succeed **Major General Alvin L. Pachnyski** as Director of Communications-Electronics, Headquarters, United States Air Force. General Grant is presently Deputy Chief of Staff, Operations, Headquarters Air Defense Command at Colorado Springs, Colorado.

William M. Richardson has been named Assistant to the Vice President and will head the Washington office of BJ Electronics, Borg-Warner Corp. Formerly with Ramo-Wooldridge Corp. as Washington representative, he will be responsible for technical liaison with Department of Defense, military services and other government agencies involved in electronic research and development.

D. C. Galassi, Chairman of the Board of Automatic Electric Co., S.A.T.A.P., Milan, Italy, a subsidiary of General Telephone Corporation, died in Rome on March 9. Mr. Galassi had been associated with the Automatic Electric group for more than 30 years and was Managing Director of the Italian affiliate from 1937 to December, 1956, when he was elected Chairman of the Board.

William N. Snouffer has been appointed Project Manager of the PLATO anti-missile missile system of the Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc. Following his retirement as an Air Force Colonel last fall, Mr. Snouffer joined Sylvania as assistant project engineer for the PLATO project.

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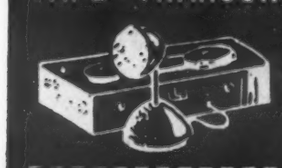

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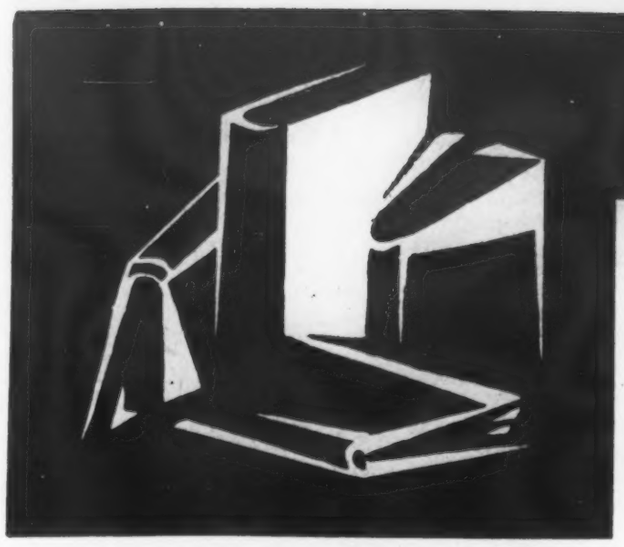

Books

THE ENCYCLOPAEDIA OF RADIO AND TELEVISION. Philosophical Library, New York. 736 pages, $12.00.

In its second edition, *The Encyclopaedia of Radio and Television* provides authoritative reference to all main aspects of modern radio and TV engineering in a manner intended to cater to both the novice or those not mathematically inclined, as well as to advanced workers. Mathematical explanations are reduced to a minimum and the treatment is as simple as accuracy will permit.

An appendix on recent developments treats, for the most part, FM VHF broadcasting and advances in TV, such as color systems.

Subjects covered are: fundamentals of radio; transmitting and receiving theory and practice (including broadcasting); TV techniques; radar; communication systems; components; measuring instruments; electrical machinery and power supply.

A separate reference section contains a number of abacs and a wide range of formulae with worked examples.

COUNTDOWN FOR TOMORROW, by Martin Caidin. E. P. Dutton and Co., New York. 288 pages, $5.00.

Where do we stand in the race for space control? How are the Russians proceeding in their bid for supremacy? Whose will be "the countdown for tomorrow?"

With absorbing detail, Martin Caidin's inspection of the earth satellite, rocket, and strategic missile programs, both of the United States and of the Soviet Union, offers an authoritative statement of timely interest to all.

Highly illustrated and written with serious and graphic presentation, the book reveals probing research in its exposition of reasons for the lag in U. S. development of earth satellites and thermonuclear intercontinental missiles, and the need for a change in leadership attitude lest we mold our destiny for worse.

TELEVISION IN SCIENCE AND INDUSTRY, by Zworykin, Ramberg & Flory. John Wiley & Sons, Inc., New York. 300 pages, $10.00.

It is believed that the broad use of TV will play an increasingly vital and beneficient role in all phases of human affairs, and the outstanding and distinguished authors of this work have endeavored here to make some contribution in book form to such progress.

After a brief historical introduction, the volume proceeds to explore the function of TV, outlining the principal fields of application of TV in industry, research, medicine, education, commerce, military affairs, home, and farm.

Analyzing both equipment and applications, the authors discuss, for the first time in book form, closed-circuit color TV and the improvements achieved by transistorization. Stereo TV, specialized TV methods in research, and TV microscopy are also covered.

The final chapter offers a forecast on the future development of closed-circuit TV.

Although the presentation is essentially self-contained and does not require more than an elementary knowledge of electronic circuitry, copious references are given to permit further exploration of particular interest.

WAR—1974, by Lt. Col. Robert B. Rigg, USA. The Military Service Publishing Co., Harrisburg, Pa. 304 pages, $5.00.

The first thermonuclear missiles leave snowy, frozen Siberia on New Year's Eve, 1974. Chicago becomes a ghastly thermonuclear crater and the New York holiday crowd transforms into a milling mob so panicked that the streets and subway entrances are full of trampled dead. By dawn, America has become essentially a nation of people living in automobiles, spreading out over the superhighway networks to small towns predesignated to serve evacuees in the event of war.

Col. Rigg's narrative is an indication of a possible future military technique, based on actual scientific, military, and technical developments now being used by our Armed Forces, in the experimental testing stage, or on the drawing boards. All are thrust in electric-paced, kaleidoscope action across a brutal panorama of future battlegrounds.

Although the work is no prediction of actual war, it offers a serious appraisal of the dimensions which a future war could take. "Unless people and governments know and understand the likely proportions of any conflict to come, they are inadequately equipped to prevent the occurrence of such an event," warns Col. Rigg.

MANAGEMENT FOR ENGINEERS, by Roger C. Heimer, McGraw-Hill Book Co., New York. 453 pages, $6.95.

The increasing involvement of the modern engineer in management decisions and responsibilities has motivated Professor Heimer's excellent interpretation of management to the engineer, acquainting him with the complexities which often dominate the decisions of business management. Those in managerial positions have become more dependent upon the engineer, and yet they find that, with regard to themselves as individuals in a coordinate organization and to the corporation as an economic institution, the decisions they make are highly foreign to the average engineer whose training has caused him to see all things as incontrovertible facts.

Professor Heimer's volume introduces the engineer to the art of manipulating those factors of production in the most economical manner possible. It is possible, the author believes, that decisions will be more conservative and that the objective thinking of the engineer will keep business on a more even keel, provided the engineer is fully acquainted with the problems of management.

ULTRA-MINIATURE PHOTOGRAPHY, by Joseph D. Cooper. Universal Photo Books, New York. 160 pages, $3.95.

Unveiling the exciting world of ultra-miniature cameras, Mr. Cooper's informative and well-illustrated handbook is designed to familiarize the reader with all presently available cameras of this type and their accessories.

A trend begun as far back as the "detective" cameras of the 1880's, the sub-miniature camera with its numerous modern improvements offers many attractive advantages and, as one masters the techniques of ultra-miniature work, he becomes a better photographer in general simply because the essentials are not greatly different from one size camera to another.

Instructions detail the taking of pictures, bulk leading by the amateur, the techniques of exposure, flash and color photography, developing, enlarging, copying, and telephotography—as adapted to ultra-miniature work.

Chapter News (*Cont. from p. 55*)

Chapter president Delbert Cravens of Southwestern Bell Telephone Company presided over the meeting, with Lloyd Dorsett, President of Dorsett Laboratories and past chapter president, introducing the members of the panel.

Focusing in particular on surface-to-surface missiles, General Wehle recalled for his audience the fact that the use of missiles in warfare was not new and pointed out that, in point of fact, an old art had been revitalized and largely through the amazing contributions of electronics. To show the variety of surface-to-surface missiles available to the Army, General Wehle described and displayed a series of scale models, which included replicas of the Dart, Honest John, Little John, the LaCrosse, Corporal, Sergeant, the Redstone and the Jupiter.

Impressive as the capabilities of these missiles were, however, General Wehle emphasized to the meeting that by themselves these weapons afforded only a partial answer to the problem of defense. In the first place, he noted, there would be no profit in firing such costly missiles unless we could first find and locate appropriate targets for them with the required accuracy. Target acquisition devices were indeed a prime concern of the Military, and here the Armed Forces again turned to the skills of electronics engineers in asking them for further contributions equal in importance to those which had already made possible the modern missile. As a second point, however, the General stressed the fact that no missile or other weapon could do away with the Military's paramount need for able men. In the case of missiles, for example, the Army needed trained technicians to service and prepare them. Here the country was fortunate to be able to call on abilities such as those shown by the high-school honor students in mathematics and science who were present that evening as honored guests of the Association, and the General felt certain that whether in industry or in the Services they and their fellows would become the skilled personnel for whom weapons alone could be no substitute.

Dr. Harlow, who is an outstanding authority on the problems and prospects of science education, has received international recognition and presidential commendation for his work. In his talk, he emphasized the need for stimulating advancement in the fields of science and mathematics from the grade-school, high-school and college levels. He also stressed the need for recognizing outstanding students in these fields and providing them with additional incentive and assistance.

Mr. Miller first reviewed the progress of the telephone industry to the present day which is characterized by the transistor and the information theory. Together, he said, these promise to affect the direction of communications development more profoundly than the vacuum tube and the principle of modulation. He also described miniaturization in the communications field and direct long-distance dialing.

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INDEX TO ADVERTISERS

American Telephone & Telegraph Co. — *N. W. Ayer & Son* 1
Arnold Engineering Co. — *W. S. Walker Advertising* 57
Bomac Laboratories, Inc. — *Larcom Randall Advertising, Inc.*.....4th Cover
Burroughs Corporation — *Campbell-Ewald Company* 4
Capitol Radio Engineering Institute — *Henry J. Kaufman & Associates*..... 42
Collins Radio Company — *W. D. Lyon Co.* 9
Daystrom, Inc., Instrument Div. — *Morse Advertising Agency* 32
General Aniline & Film Corp. Ansco Division — *Benton & Bowles, Inc.* 41
General Mills, Inc., Mechanical Div. — *Knox Reeves Advertising, Inc.* 14
Hoffman Laboratories, Division of Hoffman Electronics Corporation — *Honig-Cooper & Miner Co., Inc.*..... 53
Institute of Radio Engineers — *Raymond Schoonover Advertising* 59
International Telephone & Telegraph Corp. — *J. M. Mathes* 38
Kato Engineering Co. — *Frizzell Advertising Agency, Inc.* 6
Kleinschmidt Laboratories, Inc. — *Alex T. Franz, Inc.* 11
Lenkurt Electric Co. — *Boland Associates* 2
The Martin Co. — *VanSant, Dugdale & Co., Inc.*.....26, 27
Philco Corp., Government & Industrial Div. — *Maxwell Associates, Inc.* 47
Philco Corp., Lansdale Tube Co. Div. — *Maxwell Associates, Inc.* 29
Prodelin, Inc. — *Josephson, Cuffari & Co.* 51
Radio Corp. of America, Defense Electronic Products — *Al Paul Lefton Co., Inc.* ..... 3rd Cover
Radio Corp. of America, Electron Tube Div. — *Al Paul Lefton Co., Inc.* 36
Radio Engineering Labs., Inc. — *Thomas Franklin Burroughs Co.* 49
Radio Engineering Products 58
Scientific-Atlanta, Inc. — *McRae & Bealer, Inc.* 61
Sperry Gyroscope Co. — *Reach, Yates & Mattoon Advertising, Inc.* 23
Times Facsimile Corp. — *Thomas & Douglas, Inc.* 7
Ungarsohn, Harry 62
United Transformer Corp. — *Shappe-Wilkes, Inc.* .....2nd Cover
Westinghouse Electric Corp. — *Fuller & Smith & Ross, Inc.* 45

Why SIGNAL?

In reading newspapers and news magazines, I find information and misinformation about a number of subjects. One example is on air defense. In the February issue of SIGNAL, I found it explained. SIGNAL also has carried authoritative articles on the satellite program, on the International Geophysical Year, scatter propagation, ballistic missiles, etc. It also covers new military and commercial developments such as a sun powered automatic motion picture camera, infrared photo reconnaissance, solid-state physics, transistors, an automatic teletype distribution system, trends in facsimile, etc.

SIGNAL is not pointed exclusively at the Signal Corps. The information is of general interest to anyone who is in the communications or electronics field. It's a good magazine for anyone in those fields, in or out of government. The magazine is readable. As yet, I haven't even seen an integral sign in SIGNAL. I knew a fellow who said that whenever he came to one of those "fish hooks" he'd turn the page and start reading about something else. I don't have anything in particular against differential equations or integral signs if a person wants to go into details. Electronics has become a mighty big field, and one can't go into details about very many things.

I'm not putting myself through college, but I would like to recommend the magazine SIGNAL to you. An AFCEA membership, including 12 issues of SIGNAL, costs $5.

Dr. James Coe, Chief Engineer, Science Division, Ft. Huachuca, Ariz.

Washington

In his first address as Army Chief of Research and Development, Lt. Gen. Arthur G. Trudeau stressed the importance of communications and electronics in today's modern Army. General Trudeau spoke at the luncheon meeting of the Washington Chapter of AFCEA at the Willard Hotel on April 1st.

Speaking to a group of some 660 members and visitors—a record attendance—General Trudeau gave a dramatic projection of the Army's interest in communications and electronics, in terms of past accomplishments and in future needs and requirements. "The effectiveness of an Army, now more than ever," said General Trudeau, "is measured by its ability to move, to shoot, and to communicate. In all three areas —mobility, firepower, and communications—your Army relies heavily on electronics." (Note: Full text of address by General Trudeau will appear in the June issue of SIGNAL.

Present at the head table for the luncheon-meeting were: Lt. Gen. Arthur G. Trudeau; Maj. Gen. August Schomburg, Chief, Ordnance Research & Development Div., USA; Maj. Gen. Emerson C. Itschner, Chief of Engineers, USA; Mr. John R. O.Brien, secretary & treasurer, Washington Chapter, AFCEA; Maj. Gen. James D. O'Connell, Chief Signal Officer, USA; Mr. L. Harriss Robinson, president, Washington Chapter, AFCEA; Dr. William H. Martin, Director of Research & Development, DA; Maj. Gen. John H. Hinrichs, Chief of Ordnance, USA; Mr. Ralph A. Irwin, vice president, Washington Chapter, AFCEA; Maj. Gen. Jerry V. Matejka, Asst. to the Director for Telecommunications, ODM; Maj. Gen. William M. Creasy, Chief Chemical Officer, USA; Brig. Gen. Richard J. Meyer, Chief, Research & Development Div., OCSigO.

During the social hour, the following Army films were shown by rear-view projectors: "The Pentomic Army," "Launching of Explorer I" and "Missile Master System."

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Described as the most potent of all ground-to-air defense missiles, the Bomarc pilotless interceptor, designed by Boeing, stands poised for the destruction of any "enemy" bomber within a 200-300 mile range. Its booster rocket has the power to hurl it more than 60,000 feet straight up; then, powered by two ramjet engines, it hurtles by electronic instinct to its target at up to 3 times the speed of sound. For this guardian of our homes and way of life, RCA has been privileged to supply important advance components of the guidance system.

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It was a cold day in the Alps. But Han
great general on his way to conquer Rome, was
hot under the collar of his Punic tunic.

"How did you camel herders ever get those
stuck up there?" he bellowed, hanging precario
a ledge he shared with a mountain goat.

"I guess you could blame it on faulty ra
of the men said. "The elephants lost their way

"Well, I'll just have to leave you there!"
roared. "I have a date in Rome. Serves you

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there!" Hannibal
ves you right for

forgetting that radar just can't work in the Alps without Bomac tubes!" (The general must have been talking about Bomac's peak performance. But his watch was fast — by about 2165 years.)*

So Hannibal went down in history — but his radar stayed up in the Alps. As the History Book writes:

"In search of sundry Roman scalps,
Mighty Hannibal crossed the Alps.
But he lost his radar on the way —
The Alps crossed Hannibal, you might say."

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